The Electrical Industry's Weekly Magazine

January 13, 1958

Electrical World

Price 50 Cents

A McGraw-Hill Publication

memo from
EDITOR

TO: ALL READERS
SUBJECT: 1958 Electrical World

You asked for it. Take a look at our new, expanded "Electrical Business Outlook"--a part of the Management Newsletter in the back yellow section--and see if we've come through. It's our answer to your demands. We hope you'll like the format changes throughout the book.

the editor

memo from
THE EDITOR

TO: SECRETARIES ONLY
SUBJECT: 1958 Electrical World

Want to make a hit with the boss? It'll be helpful to him if you'll tear out the Electrical Newsletter and air mail it to him when he's away on business trips. You'll find this section up front on the yellow pages.

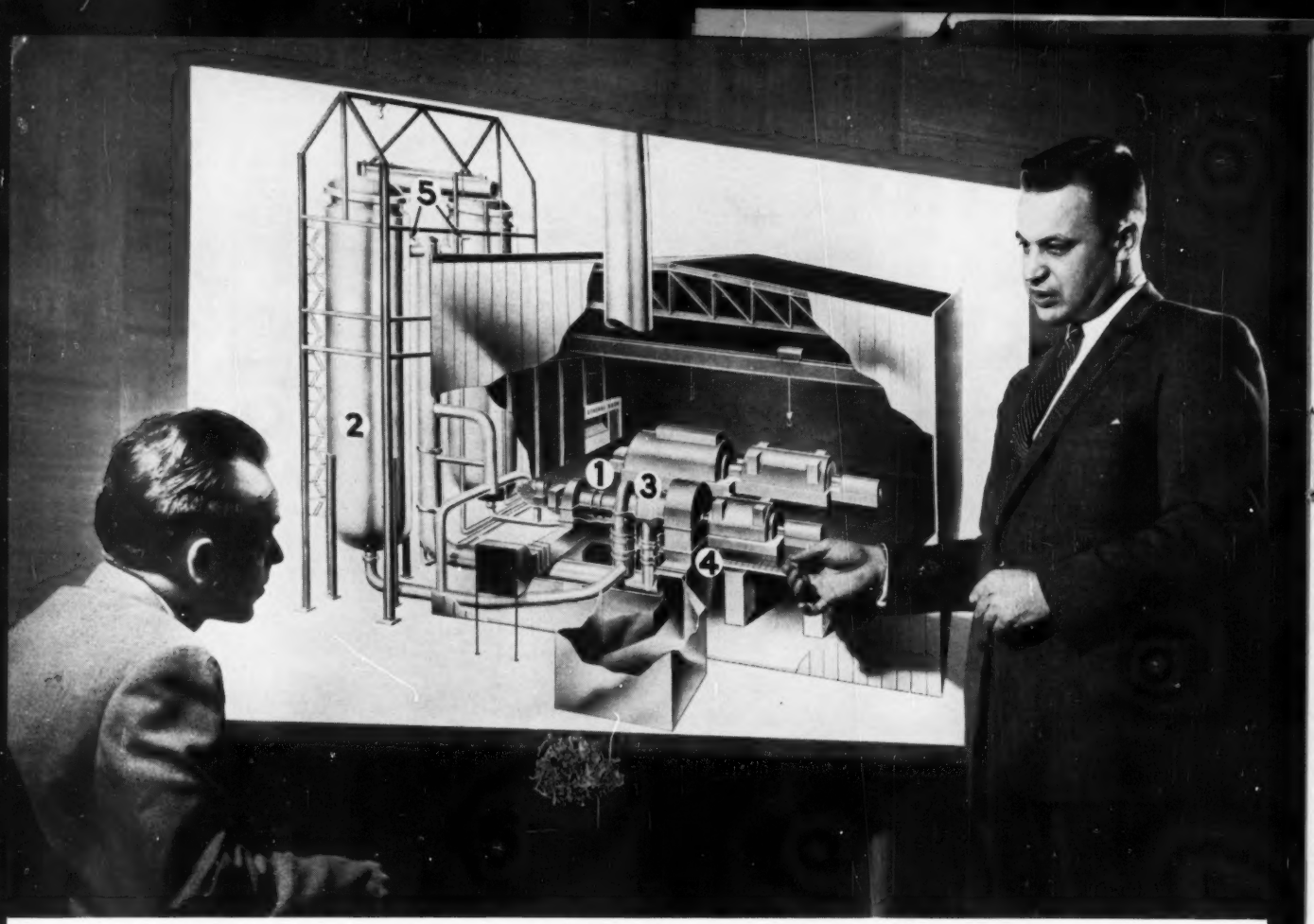
the editor

ILITY EXECUTIVES
SUBJECT: 1958 Electrical World

Hard up for reading time? You'll find the 1958 changes in Electrical World right down your alley. Notice the more inviting format of the yellow sections. And take a look at the new feature, "Executive Reader," in the Electrical Newsletter on the front yellow pages.

the editor

E B POWER
UNIVERSITY MICROFILMS IN
313 N 1 ST
ANN ARBOR MICH



COMBINED GAS-STEAM CYCLE begins as air enters compressor (1) and is discharged to boiler (2). From boiler, gas enters gas turbine (3), and exhausts (4) to economizer, stack gas cooler, and stack. Steam at (5) goes to steam turbine. The supercharged boiler design shown in the illustration above appears through courtesy of Foster Wheeler Corporation. Discussing economies of new combined-cycle power plant are General Electric's W. D. Marsh (left), Engineering Planning & Development Section, and H. A. Carlson, Gas Turbine Department.

General Electric announces 133,500 kw combined gas-steam cycle power plant

These benefits are expected:

- **6% lower heat rate**
- **reduced boiler weight and volume**
- **low plant investment**
- **faster plant start-up**

The combined gas-steam cycle power plant offers promise of major heat rate gains. In this respect, the combined-cycle plant is one of the most significant developments in the electric power generation field since the General Electric Company installed the first steam turbine-generator unit using the modern reheat cycle in 1950.

General Electric turbine engineers expect net station heat rate for this gas-fired, combined gas-steam cycle to be 9,413 Btu/kw-hr—with little or no increase in plant investment. This rate compares with 10,045 Btu/kw-hr for a conventional steam cycle using a similarly rated, tandem-compound, double flow unit of the same steam conditions.

Looking still further into the future, General Electric engineers expect operating experience with a gas-fired plant to help speed the adaption of the combined cycle to oil- and coal-fired plants. For more information on how your utility can achieve lower cost generation by applying this new plant, contact your General Electric Apparatus Sales Office, or request bulletin GER-1452 from General Electric, Section 301-372, Schenectady 5, N. Y.

LIVE BETTER ELECTRICALLY

MORE POWER TO AMERICA

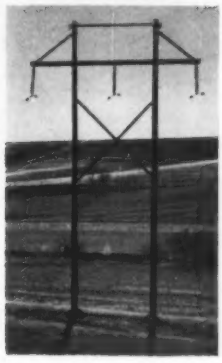
GENERAL ELECTRIC

Electrical World

Vol. 149, No. 2 JANUARY 13, 1958

Published for 84 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

In This Week's Issue



CURRENT EVENTS

Utilities Focus on Engineering Manpower

EEI survey probes engineering compensation, promotions, recruitment; indicates continuing shortage through '65....p 50

GENERATION

Delayed Coke Cuts Production Costs

John M. McGurn, Virginia Electric & Power Co

Mixed half and half with coal, it's burned by new specially designed 150-Mw unit at Vepco plant.....p 64

INDUSTRIAL

Revamp Plant Distribution to Match Growth

Walter H. Proescholdt, The Quaker Oats Co

New system design for Quaker Oats' Cedar Rapids mill stresses safety and economy.....p 61

TRANSMISSION

Iowa P&L Creates New H-frame Design

Earl E. Campbell, Iowa Power & Light Co

It offers better tower performance during storms, cuts wire shield failures, eliminates crossarm bowing.....p 58

SYSTEM ENGINEERING

Here Are ABC's of Computer Programing

F. J. Maginniss, General Electric Co

Step-by-step procedure is outlined in solution of expression e^x by hypothetical digital unit SADSAC.....p 54

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Installing 15,000-volt Loxarmor feeder (above). Single pulls as long as 1,600 feet were made around corners (right) without resorting to splices. A half-inch stainless steel messenger was used.

15kv Loxarmor® aerial feeders replace bare wires at refinery

In replacing bare wire aerial feeders that had proved unreliable in bad weather and had, on several occasions, shorted out and burned down, a Texas refinery installed nearly 8,000 feet of Okonite oil-impregnated, paper-insulated, lead-sheathed Loxarmor cable. Protected with an interlocking S-shaped bronze armor (Loxarmor), this cable has proved itself 100% reliable. The Loxarmor provides mechanical protection against movable drag lines, cranes, and the like.

Here is one example of how industry uses versatile Loxarmor cable—the modern conduit-type cable that's mechanically strong, flexible and versatile. For either power or control circuits, Loxarmor cable has proved itself time and again to be economical . . . easy to install indoors or outdoors . . . easy to move and re-route . . . easy to inspect and maintain . . . completely reliable and dependable.

Loxarmor can be supplied over any standard Okonite insulation, rubber, plastic, paper or varnished cambric—depending upon your installation conditions and voltage requirements. It is available in galvanized or stainless steel, aluminum or bronze. For full details, contact your local Okonite representative or write to The Okonite Company, Passaic, New Jersey.

where there's electrical power... there's **OKONITE CABLE**

4845

Face Up To Inflation

In New York we subway riders have just settled with Michael J. Quill and his Transport Workers Union. After going through a prolonged series of conferences (taking at least two full days) the negotiators finally brought the increase down from Quill's request of 65¢ per hour to 32½¢ per hour.

This inflationary move has taken place at a time when the country is obviously in a recession. It happened after all efforts of the monetary managers had proven useless. Control of credit and interest rates can curtail an economy thereby reducing business, profits, and employment. But something else is essential in the formula for halting the continuing inflation.

The predictions for 1958 are uncertain in all categories but one. The one that is agreed to by all is that labor costs will go up again. The case of Mr. Quill will be repeated many times in 1958.

One utility, I know, adds a 5% per year inflation increment to construction estimates. This seems like a smart idea.

It seems that the utilities and the country must face inflation during bad times as well as good times as long as labor leaders can wield the big stick.

Fischer Black

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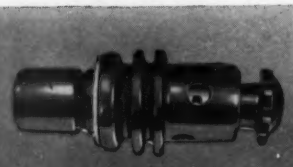
Here's why Wagner Form W Transformers are EASIER TO INSTALL . . . GIVE LONGER SERVICE LIFE

The small size and light weight of Wagner Form W Transformers makes them easy to handle—easy to mount on poles. Smooth, rounded lifting lugs—chuck type terminals with insulated hand knobs—key-locked bushings all combine to make installation easier.

These transformers give longer service life because of their liberal design that gives excellent electrical performance with high overload capacity to handle peak loads—their air-tight cover seal that prevents oil contamination—their electrically welded tanks and durable paint finish.

A few of the features of these modern distribution transformers are shown below.



HIGH VOLTAGE SIDEWALL BUSHING

Permits faster, safer connections because chuck type terminal eliminates need for tools, and insulated hand knob protects lineman when tightening terminal. Takes either copper or aluminum conductor. (Used on transformers 5 KV and below.)

LOCKED LOW VOLTAGE BUSHING

Bushing and terminal are double locked to prevent slipping or turning when terminals are tightened. No loose inner terminal connections to cause short circuits.

SHUR-SEAL COVER CLAMP

Seals tank cover airtight . . . no atmospheric moisture or dust particles can get inside to contaminate oil and shorten transformer life. No oil can leak out during shipping or handling.

FORM W ELEMENTS

Cores of cold rolled oriented grain transformer steel are assembled through and around the pure copper coils. Thermo-setting insulation bonds coil element into a solid unit, which is braced to prevent any possibility of shifting.

Wagner Form W Transformers are available in single-phase ratings, 500 kva and smaller, 69 KV and below, in conventional or protected types. All ratings from 3 to 167 kva, 15 KV and below, are designed for pole mounting.

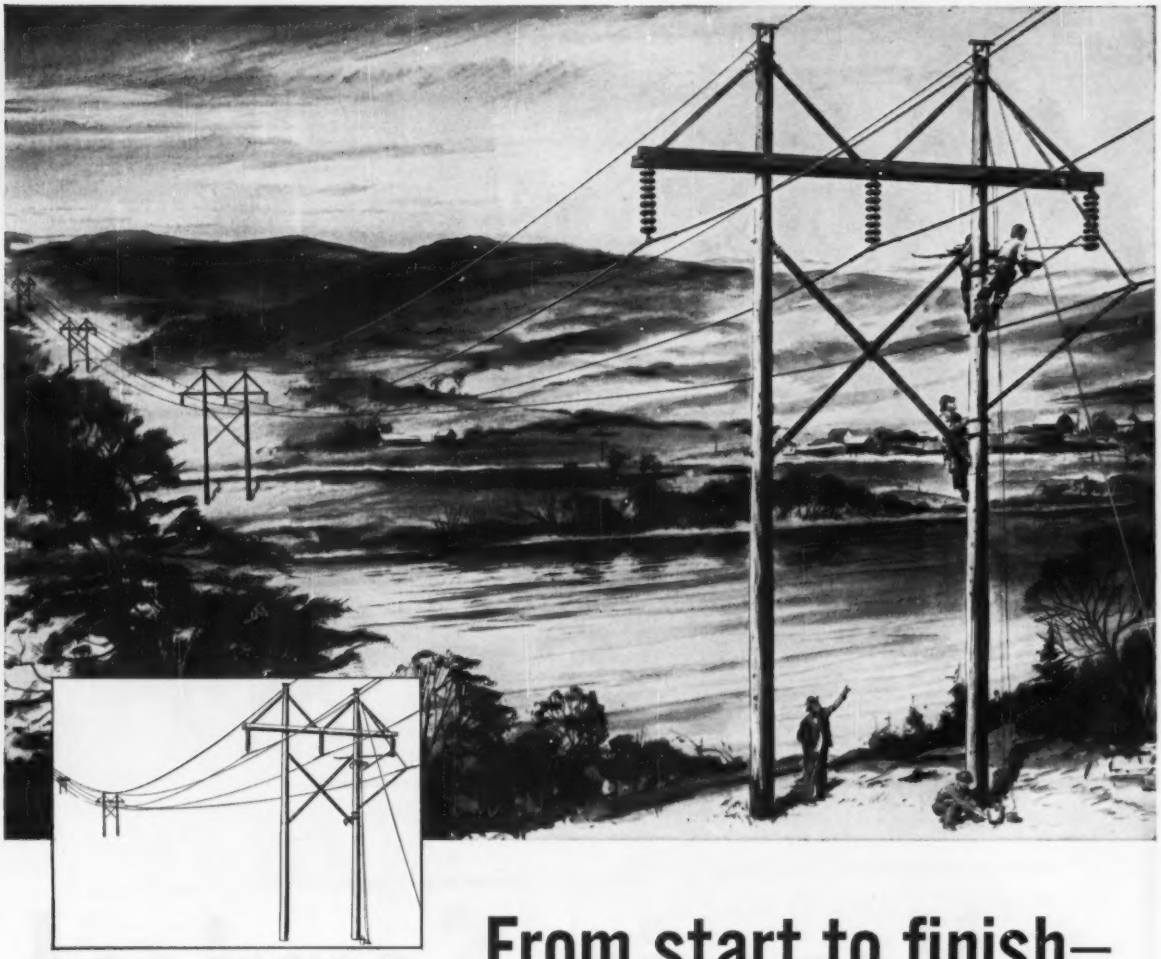
Wagner Electric Corporation
SERVING INDUSTRY SINCE 1891

WT58-3

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

Wagner Electric Corporation
6456 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC



Graybar can supply everything that's shown above — except linemen and scenery — for line construction *and* maintenance. Poles, crossarms, hardware, tools—a partial list of items that are stocked at strategic Graybar locations throughout the country. All available for fast delivery to you. It pays to call Graybar . . . *first.*

From start to finish— arrange for continuing supplies and equipment—with Graybar

Engineers deep in the problems of new transmission *line construction* must be able to depend upon reliable, on-time deliveries to keep their schedules. And later, to meet the continuing task of *line maintenance*, the selection, dependable delivery and warehousing of supplies and equipment are vital.

Graybar backs up design and construction engineers to speed up these processes. Through more than 130 offices and warehouses, Graybar supplies prompt catalog information on everything electrical needed in line construction and maintenance.

To speed up the selection and delivery of anything and everything you need for line construction and maintenance call Graybar first. *Graybar Electric Company, 420 Lexington Avenue, New York 17, N. Y.*

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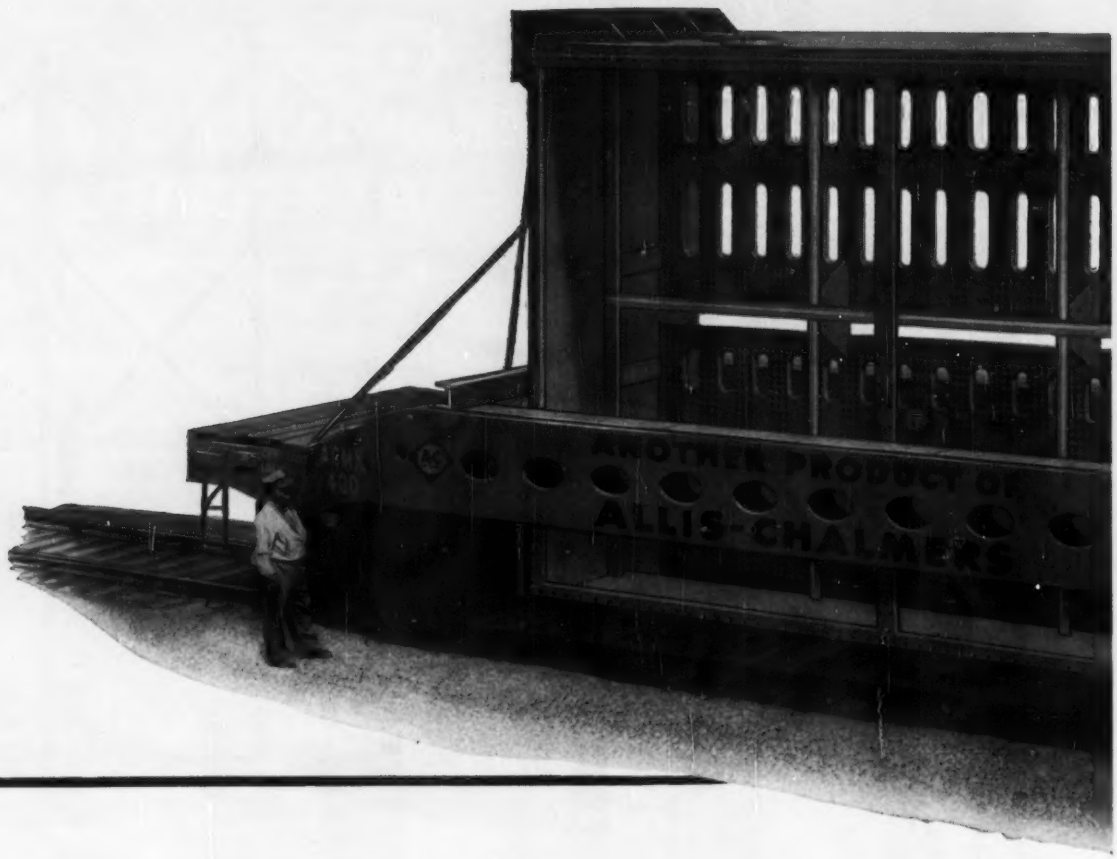


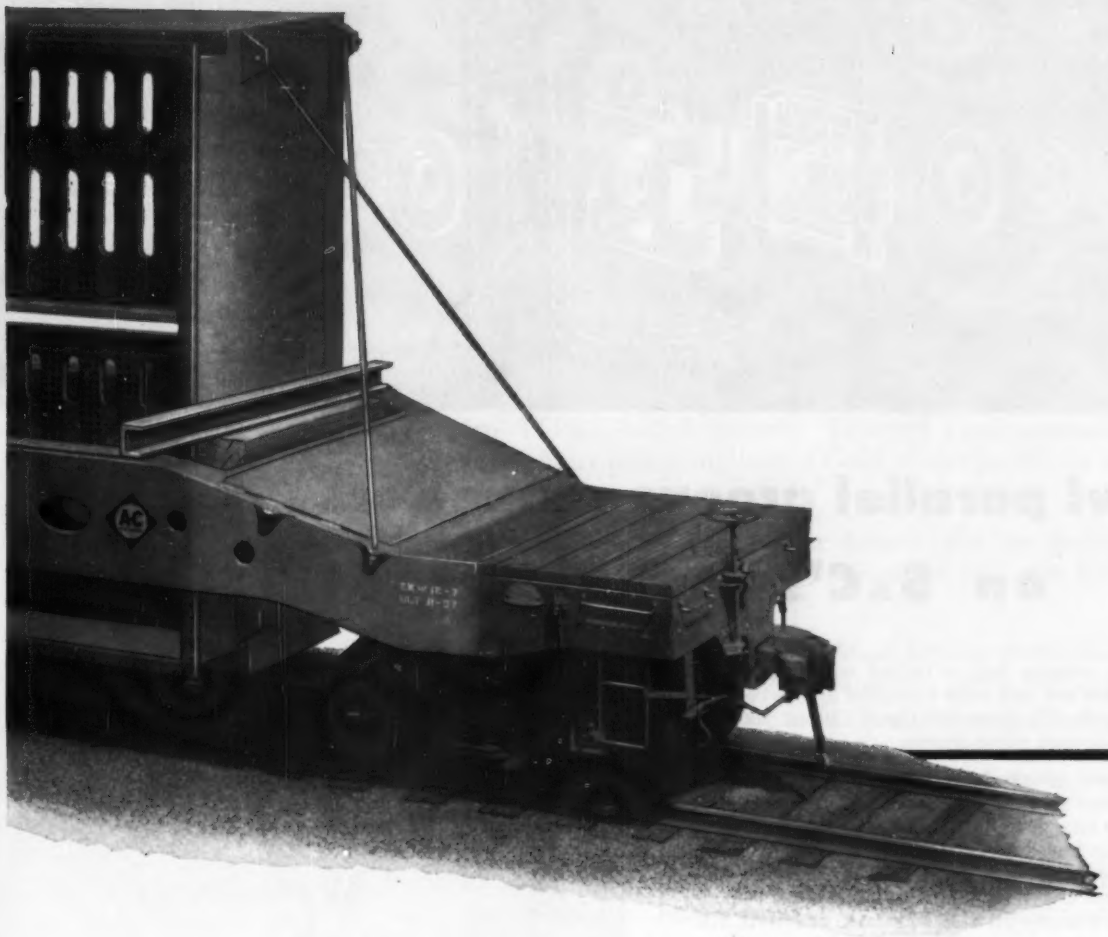
Now in Service!

New well-center cars reduce condenser erection time and costs

For details, call your nearby A-C representative or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin

A-C
ALLIS-CHALMERS

A-5453



These new Allis-Chalmers cars, specially built to A-C design, carry loads of greater dimension than any conventional car can handle . . . permit shipment of larger shell sections, cut erection time at the job-site.

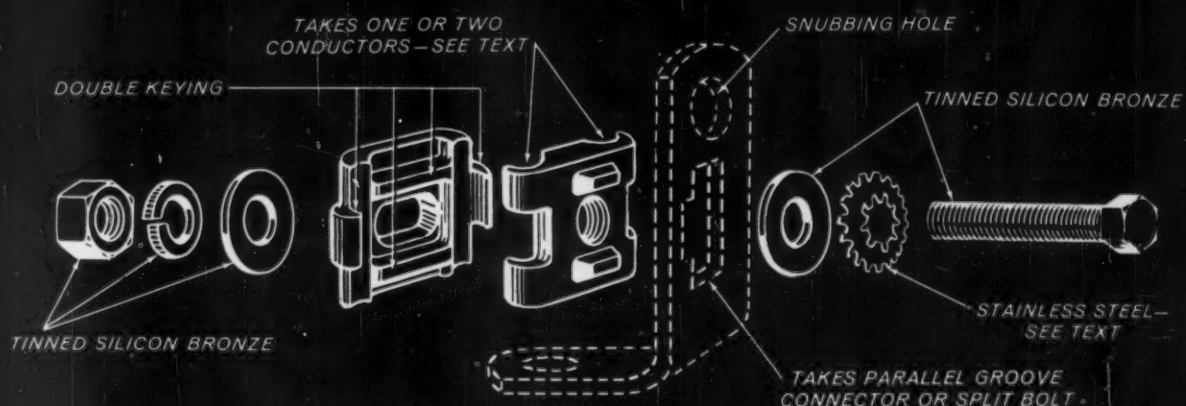
With an overall width of 12 feet 7 inches, these cars take shell sections up to 30 feet long, 10 feet wide, 18 feet high. Cars used previously could take sections only 7½ feet wide.

This solution to the problem of transporting continually larger condensers to ever larger power plants is an example of the attention given to *all* the problems involved in building condensers — research, engineering, manufacturing, shipping, erecting, servicing. When you specify Allis-Chalmers you get complete engineering for optimum efficiency.

Matched Auxiliaries

Whatever your requirements may be in size or shape, Allis-Chalmers can supply surface condensers and all necessary auxiliaries — circulating pumps, condensate pumps, motors, air ejectors, controls, valves — all engineered by Allis-Chalmers.

ALLIS-CHALMERS



now! parallel groove connectors on S&C's Open Cutout

If you're coming into a cutout with aluminum, chances are you will want a parallel groove connector. With S&C's Type XS Open Cutout you can have this feature at no charge.

Expressly designed for use with aluminum conductors, this new parallel groove connector has an unusually large gripping area. The connector halves are doubly keyed to each other, insuring uniform gripping of conductor, regardless of size. The connector takes one or two aluminum conductors—copper too, of course—up to 2/0 stranded or 1/0 ACSR.

Making connections is easy. Connector halves are keyed to each other and to the cutout to prevent rotation. You need only one wrench to make up the connectors, since a stainless steel internal-external tooth lockwasher holds the connector body mounting bolt against turning. And, for each tightening of the connector with lineman's tools, there is a generous size nut—5/8" across flats.

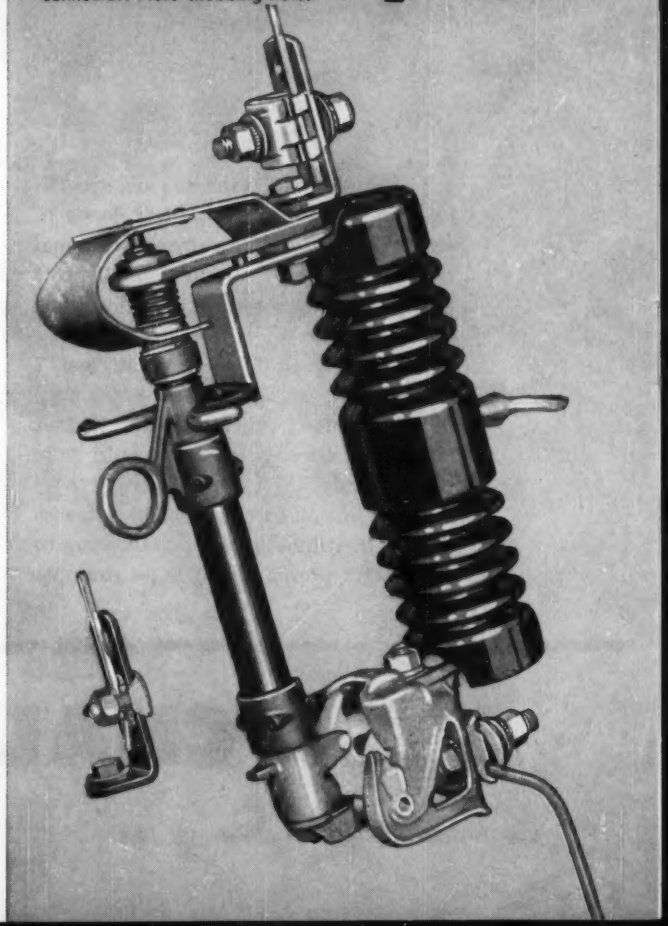
Larger parallel groove connectors are available at slight charge. These connectors accommodate one or two conductors, from No. 2 solid aluminum (or copper) to 4/0 standard aluminum, copper, or ACSR.

As an optional standard the split-bolt connector is available at no extra charge. Maximum conductor size is No. 1 stranded—copper or aluminum.

S&C Electric Company, 4421 Ravenswood Ave., Chicago 40, Ill. In Canada: S&C Electric Canada, Ltd., 8 Vansco Road, Toronto 14, Ont.

S&C ELECTRIC COMPANY

Type XS Open Cutout—7.5 kv, 100 amperes continuous, 12,000 amperes interrupting—shown with parallel groove connectors. Insert (below) shows optional split-bolt connector. Note snubbing hole.



The News-Scope

LATE NEWS ▶ **Wisconsin PSC rules** cost of "public-private" electric utility advertising must be charged to miscellaneous income deductions. Costs thus cannot be figured into rate-setting.

REA okays contract for 18 Minnesota co-ops who will get 52,600-kw Missouri Basin power from USBR. Northern States Power, Otter Tail Power, and Interstate Power will wheel the power.

Tip-off: Advise dealers, customers about Chicago Home Furnishings Show Jan. 17-26. Added features: $100,000 Commonwealth Ed-Merchandise Mart promotion with a Gold Medallion Home as first prize.

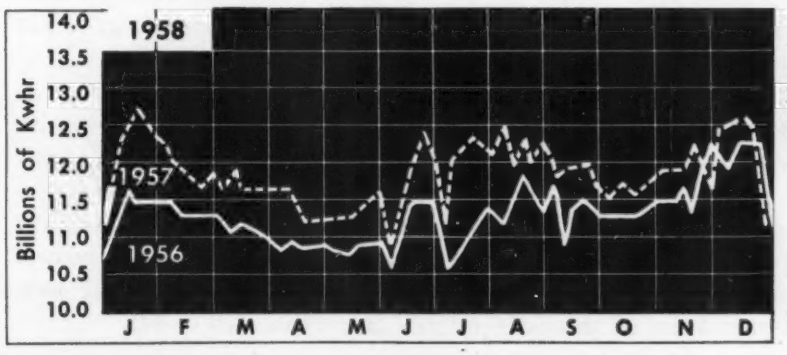
Because Capital Electric Power Assn doesn't have the facilities to serve a new Jackson industrial plant, Mississippi P&L gets PSC nod to serve it. An appeal is likely.

Management promotions . . . Middle West Service elects Robb M. Winsborough vp in charge of public relations, personnel, organization and management, and Malcom R. Rodger as vp in charge of marketing and sales promotion . . . Robert E. Pierce becomes chief consulting engineer for Ebasco Services, replacing H. L. Melvin who continues in a general engineering consulting capacity.

FUTURE NEWS ▶ **Next AEC organizational change** may be established of an office of hearing examiner. FCC's Ass't Chief Hearing Examiner J. A. Kyle, now on loan to AEC, may head it.

Joint Committee on Atomic Energy hopes to hold "202" hearings (required by law to review civilian atomic power status) about Feb. 17. It also hopes to squeeze in hearings on basic research, emphasizing thermonuclear status here and in Britain.

Power Output—Up 0.2% (Week ending Jan. 4), Kwhr 11,692,000,000
Up 0.2% (Week ending Dec. 28), Kwhr 11,218,000,000



Per Cent Change From Previous Year

	Dec. 21	Dec. 28	Jan. 4
Total U. S.	+1.5	+0.2	+0.2
New Eng.	+0.6	+0.1	−2.9
Mid. Atlan.	+0.7	−0.1	−1.3
Cent. Ind.	−1.7	−2.5	−2.5
West Cent.	+1.2	+1.7	+3.7
Southeast	+2.8	−1.0	+2.0
South Cent.	+5.8	+7.3	+5.5
Rocky Mount.	+4.9	+4.7	+3.8
Pacific			
NW	+2.5	−1.6	−1.8
SW	+5.4	+5.6	+0.9

Seasonally Adjusted Index 228.0

Week Ago 224.8 Year Ago 224.9

Atomic Energy Commission requirements—1,050,000,000 Kwhr (Electrical World estimate). Excluding AEC, output increase was 1.2%

The Electrical Week

ATOMIC PROGRESS ▶ **Argonne scientists discover they can step up operating power** level of the experimental boiling water reactor "far beyond" its design level, reducing power cost by one-third . . . AEC splits its regulatory and non-regulatory functions **(p 47).**

WASHINGTON ▶ **Rep Earl Chudoff (D-Pa.) resigns** to become a Philadelphia judge. No one yet named to succeed him as chairman of the subcommittee on public works and resources . . . Senate Interior Committee reveals communist progress in pushing hydropower and other public works, hoping to hold the line on our domestic projects **(p 46)** . . . Federal Power Commission staff recommends changes in Niagara project that could add $17.5 million to its cost **(p 49).**

EVENTS ▶ **Only 8% of 88 utilities exceeded their winter peak estimates,** because of mild weather and industrial cutbacks **(p 44)** . . . Hoosier Cooperative Energy's application for a generating and transmission loan from REA stirs more talk as costs seem likely to climb. Another development: A southern company, which under the plan would take a big share of the co-ops' power output, is reported to be studying sites elsewhere for its proposed aluminum-reduction plant **(p 45).**

MANPOWER ▶ **The engineering shortage is likely to get worse** before it gets better, an EEI survey reveals. We'll be short of engineers for eight years, partly because many high school students are shying away from the basics—algebra, physics, chemistry. Other ill winds: Inadequate college facilities and faculties; teen-agers not being told of engineering's promises. Survey shows utilities pay top salaries to higher percentage of its engineers than does general industry. Here's a bang-up study of a critical problem facing American industry **(p 50).**

THE OUTLOOK ▶ **The economy enters 1958 with a mild downswing** well under way—a little sharper than expected. Industrial production will continue to fall in months ahead, but overall decline should be less than a mild 3%. The utility outlook remains bright, for biggest production cuts are coming in industries that are relatively light users of power. Heavy electrical manufacturing this year may not quite match the '57 record high. Production may be down 5% at year's end **(p 101).** But manufacturers, through NEMA, see a more optimistic overall picture for 1958 **(p 103).**

SYSTEM ENGINEERING ▶ **SADSAC isn't a real computer, but it comes to life** in an illustrative article which tells how to talk to an electronic robot to make it work tough engineering problems for you. Author F. J. Maginniss carries you step-by-step through the fascinating process of calculating the natural logarithm "e" to the "x" power. Three pages later an answer emerges, along with the statement that a medium or large-size computer can run off this little problem in milliseconds **(p 54).**

GENERATION ▶ **Savings in fuel costs are more than offsetting** a slightly poorer heat rate at Vepco's Yorktown power station where delayed coke, a by-product of oil refining, is being mixed with bituminous coal to fuel a 150-Mw unit. The delayed coke mixes 50-50 with coal to yield a stable fire at various station loadings. It has its advantages—and drawbacks, too. Here are the special arrangements required for this fuel modification, and inherent problems still awaiting solutions **(p 64).**

TRANSMISSION ▶ **New H-frame designs, using angle iron crossties** instead of vee-braces, have been created by Iowa Power & Light and a manufacturer to overcome some serious problems, including structure failure during storms. Through elimination of center vee-braces, the company saved $25,500 on a new 161-kv line. Innovations include double path to ground for lightning, crushed-rock backfill to eliminate pole pull-out due to uplift forces, and a new five-pole deadend structure for easy construction and reduced cost **(p 58).**

INDUSTRIAL ▶ **A potentially explosive atmosphere dictated caution** in the rehabilitation of a distribution system in Quaker Oats Co's Cedar Rapids mill. To enhance safety, the company added an extra margin of interrupting capacity for all switching devices, chose three-phase squirrel-cage induction motors for areas subject to clouds of dust, and designed its own motor starters using special rubber gaskets for dust-tight seals **(p 61).**

NEW EQUIPMENT ▶ **Hydraulic pike has a 3,000-lb capacity and an 18-in. lift.** A pair will align the heaviest pole . . . New 600-v switchgear permits breaker door to be shut with breaker in disconnected, test, or connected position . . . Heavy-duty cutout has ratings of 10,000 and 8,000 amp in 7.7- and 15-kv sizes, respectively **(p 86).**

MANUFACTURERS ▶ **Circuit breaker successfully interrupts nearly 14,000 Mva** in 345-kv tests at AG&E's Philip Sporn station. This is believed to be the highest yet developed in field tests **(p 109).**

SELLING ▶ **Keeping poultry water warmed electrically** is a "very desirable" load in Alabama where temperatures dive to zero **(p 80).**

PEOPLE ▶ **West Penn Power Co promotes C. M. Skooglund** to coordinator of engineering. K. N. Reardon becomes chief electrical engineer . . . Long Island Lighting Co elects W. O. Smith vice president . . . Southern California Edison makes T. M. McDaniel, Jr, vice president; and Bruce Renwick, vice president and senior counsel **(p 114)** . . . R. D. Maxon will join Sargent & Lundy April 1 as senior consulting engineer . . . Westinghouse Vice Pres J. K. Hodnette wins AIEE's Edison Medal for 1957 **(p 118).**

"Original cost" approach for rate making has defects but a shift to "fair value" or "current cost" has significant drawbacks and injustices. These disadvantages and the major administrative problems of changing the legal valuation procedure leads almost inevitably to the conclusion that original cost basis with all of its recognized imperfections must be maintained. —**Public Utilities Fortnightly, Dec 19, 1957.**

Survivors in the A-power plant business are trying every trick to save money as costs climb higher. Consolidated Edison Co expects to save close to $1 million with design changes permitting reduction in the size of the containment sphere (EW Oct 21, p44). Changing from a silver cadmium to a boron steel alloy control rod will reduce the cost of the rods from $6,000 each to $2,500 for the Dresden nuclear power plant. —**Business Week Dec 7, 1957.**

Early low-power operation of the sodium reactor experiment has gone well. Lessons learned with this 6.5-Mw sodium-cooled reactor, which went critical last summer, indicated that the rather slow approach to full power required for the SRE would not be required for future plants of this type. Maintaining the oxygen content of the sodium at 10 ppm with cold traps has been relatively easy at normal operating conditions. But attaching the traps with flanges rather than welding them in place will simplify maintenance operations. — **Nucleonics, Dec 1957.**

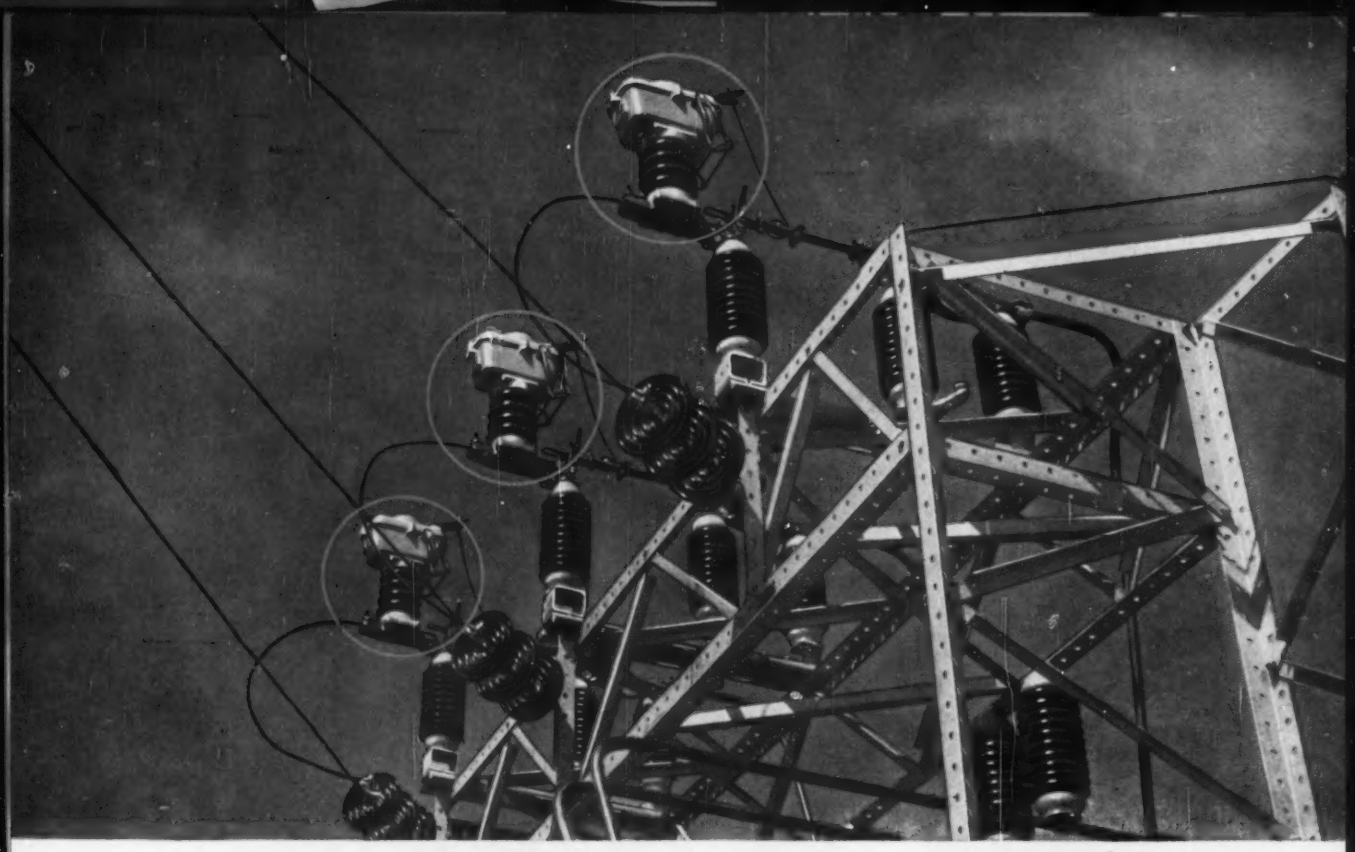
Development of a new electrode permits welding 3 to 4-in. thick steel plates for the pressure vessels of Britain's gas-cooled nuclear reactors. It is a basic low-hydrogen electrode suitable for use in all positions and capable of depositing homogeneous and sound weld metal having high impact resistance throughout the whole thickness of the weld. — **The Welder, July-Sept 1957.**

TECHNICAL NOTES

Bricks made of 80% fly ash and 20% clay will be manufactured at a power plant in Great Britain according to the Electrical Journal. With a supply of clay at hand, the cost of the bricks will be lower than the cost of traditional clay bricks.

FROM EDITORS IN THE FIELD

Telescoping hot sticks for operating disconnects and re-fusing cutouts is saving Louisiana Power & Light Co time and money by eliminating the climbing of poles. The sticks consist of seven 4½-ft sections of tubular fiber glass, rated at 75,000 vpf.



THE NEW L-M OIL INTERRUPTER provides high-speed circuit interruption on sub-transmission circuits without external arc or flame. The unit costs less than half as much as other interrupters for the same application.

New High-Voltage Oil Interrupter For Only $290 Per Pole for 69 kv

Units cost less than half as much as other interrupters for the same application—$240 per pole for 23 kv and 34 kv, $265 per pole for 46 kv, and $290 per pole for 69 kv.

Now you can get an economical, high-voltage oil interrupter for sectionalizing and switching on sub-transmission circuits. The unit is capable of interrupting load currents, line charging currents, and transformer magnetizing currents. It easily meets NEMA and AIEE standards, including the ice test.

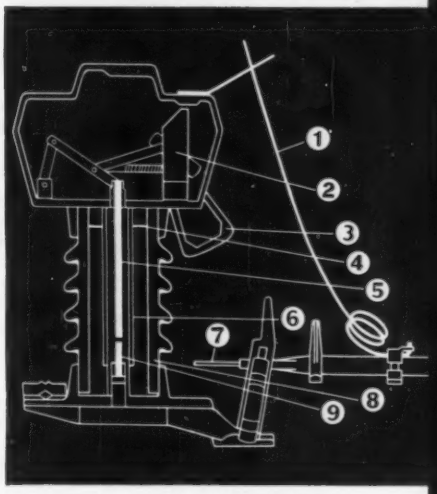
Contacts Separate At High Speed

The L-M interrupter consists of an oil-filled unit housed in a porcelain insulator, and a rod to shunt the current through the interrupter while the main switch blade is being disconnected. As the switch blade rises, it engages a spring trip lever which rises to over-toggle position, causing the contacts within the unit to separate under oil at high speed. The speed of the moving contact is independent of the operation of the main switch blade.

Contacts have long-life copper-tungsten arcing tips. All linkages are made of aluminum for lightness and fast operation. A simple fiber-washer arrangement provides a spiral passage for the pressure-generating arc, forcing oil and un-ionized gas around the arc core as the moving contact is withdrawn. This assures rapid arc extinction at low current values.

Ratings 23 kv Through 69 kv

L-M's new interrupter is available in 23, 34.5, 46 and 69 kv ratings. Continuous current rating is 600 amperes; momentary and short-time current ratings are 40,000 amps. for 10 cycles, and 25,000 amps. for 4 seconds. The unit can be installed on any of L-M's PV switches without altering the original parts. The addition of the interrupter does not change the electrical clearance or the phase spacing of the switch.



Cutaway View of Oil Interrupter

1. By-pass rod
2. Toggle mechanism
3. Trip lever
4. Oil level
5. Moving contact
6. Interrupter
7. Trip rod
8. Bushing
9. Stationary contact

Get Complete Information

Ask your L-M Field Engineer for more complete information on L-M's new high-voltage oil interrupter and on L-M's outstanding power switching equipment. Or write Line Material Industries, Milwaukee 1, Wis.

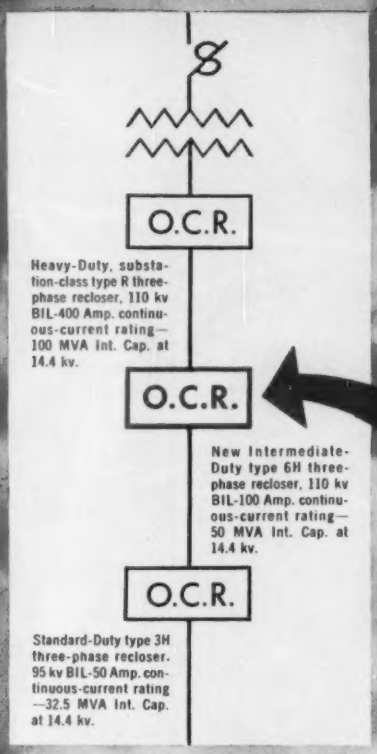
317

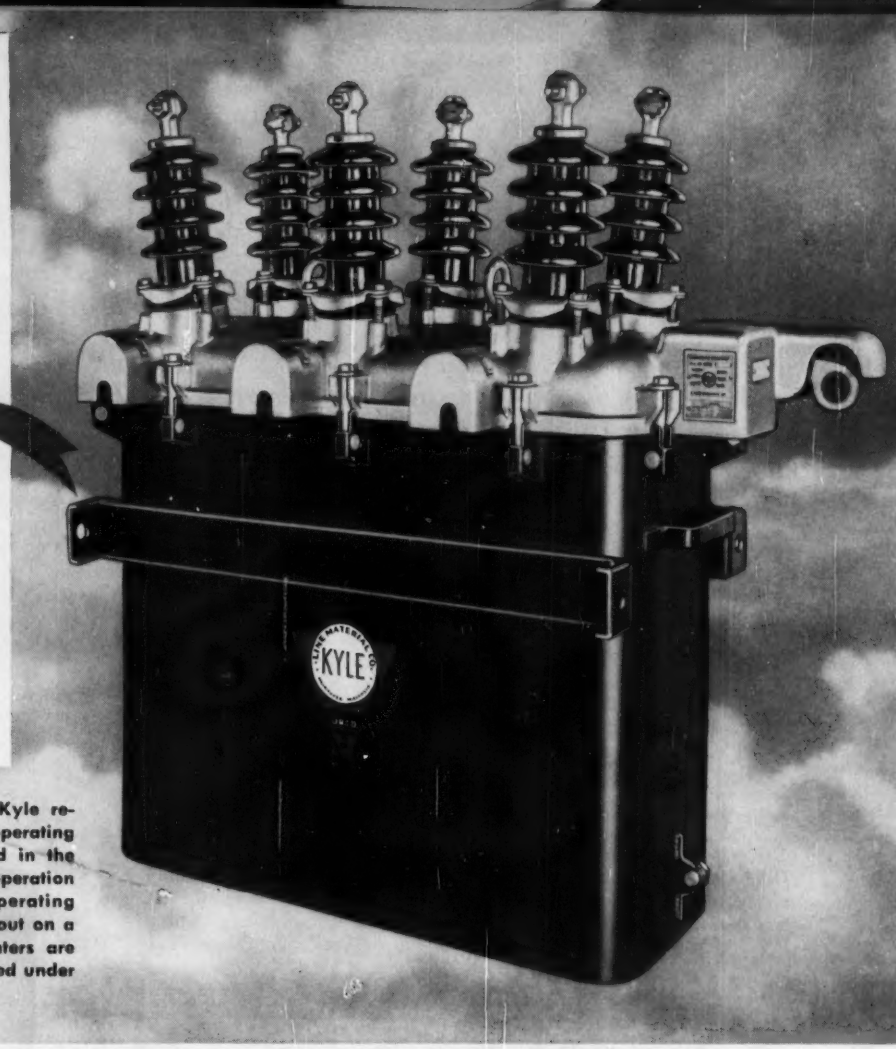
LINE MATERIAL Industries

McGRAW-EDISON COMPANY

LM Power Switching Equipment

McGRAW EDISON


O.C.R.
Heavy-Duty, substation-class type R three-phase recloser, 110 kv BIL-400 Amp. continuous-current rating—100 MVA Int. Cap. at 14.4 kv.
O.C.R.
New Intermediate-Duty type 6H three-phase recloser, 110 kv BIL-100 Amp. continuous-current rating—50 MVA Int. Cap. at 14.4 kv.
O.C.R.
Standard-Duty type 3H three-phase recloser. 95 kv BIL-50 Amp. continuous-current rating—32.5 MVA Int. Cap. at 14.4 kv.



Pole-mounted intermediate-duty Kyle reclosers are easy to operate. The operating lever is trip-free. It can be held in the closed position during tripping operation without recoil. Releasing the operating lever allows the recloser to lock out on a permanent fault. Operation counters are four-digit mechanical type mounted under the sleet hoods.

L-M Announces New Intermediate-Duty Kyle® Reclosers For Overcurrent Protection

New type 6H 3-phase reclosers incorporate all outstanding features of L-M's high-speed Kyle reclosers; available in 5 to 100 ampere ratings, 2.4 to 14.4 kv; symmetrical interrupting ratings to 3000 amps. Type 4H single-phase, intermediate-duty reclosers also available.

By **WILLIAM J. WEINFURT**
Chief Engineer
Kyle Products
Line Material Company

L-M's new type 4H single-phase and type 6H three-phase reclosers are self-contained, intermediate-duty units, designed to segregate permanent faults, and to clear transient or non-persistent faults on urban and rural distribution systems. They provide high-speed circuit clearing in less than 2 cycles with symmetrical RMS interrupting ratings up to 3000 amps. 4.8 kv and below, and 2000 amps. 14.4 kv.

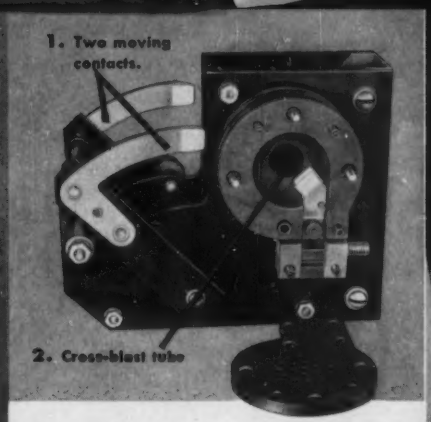
Retain Kyle Design

All the outstanding features of L-M's Kyle reclosers are incorporated in these new intermediate-duty reclosers. The timing mechanism is the service-proved Kyle hydraulic system with a selection of three time-current characteristics: Fast (A), Retarded (B), and Extra Retarded (C). Sequences can be easily adjusted for 2, 3, or 4 operations to lockout in any combination of operations. The type 6H provides single-phase tripping with operation counter for each phase, but lockout of one phase causes simultaneous lockout of all phases.

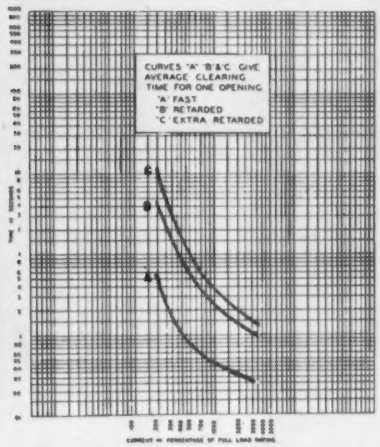
Contact Structure

Contacts and arc interrupter structure utilize the snap toggle contact action and cross-blast arc extinction principle. The cross-blast consists of two arcs drawn in series as the contacts part. Pressure

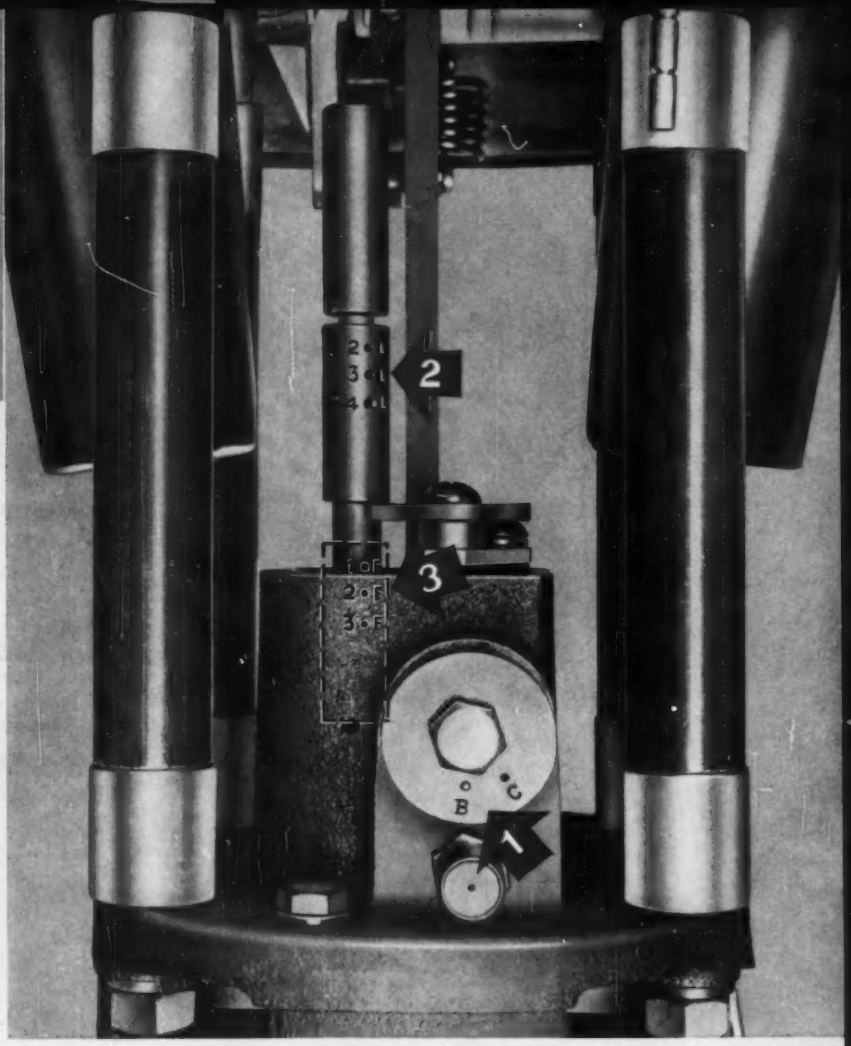
LINE MATERIAL
McGRAW-EDISON COMPANY



The new intermediate-duty reclosers utilize the service-proved cross-blast arc extinction principle. Two arcs in series are drawn as the contacts part **(1)**. Pressure generated by one arc forces oil into the path of the other arc, cooling it and extinguishing it rapidly. Note the long double-break **(2)** and cross-blast tube connecting the two interrupting chambers.



Time-Current Curves for series overcurrent tripping of L-M's intermediate-duty Kyle reclosers. Each phase of the type 6H trips individually until the final pre-selected operation, when all three phases lock open simultaneously.



Time-current characteristics and operating sequences can be easily adjusted in the field. Photo shows the hydraulic system of the type 6H recloser. Time-current characteristic is selected by moving disc to curve "B" or "C" **(1)**. Number of operations to lockout is selected by adjusting vertical extension of lockout piston **(2)**. Adjustment of sequences (number of fast and delayed operations) is obtained by the proper positioning of the roll pin located at **(3)**.

generated by one arc forces oil into the path of the other arc, cooling it and extinguishing it rapidly. Arcing time over the range of fault current ratings averages less than one-half cycle.

Moving contacts are silver-plated copper tungsten to reduce pitting and assure long life to the arcing surface. In operation, the moving contact wipes into the stationary contacts, thus insuring a cool, low-resistance, load-carrying contact. In addition, all current-carrying parts of the contacts are silver-plated.

External Construction

Terminals are universal plated type and will accommodate either copper or aluminum from No. 6 solid through 250 MCM stranded in either a vertical or horizontal position.

Bushings are wet-process, 15 kv porcelain, externally clamped to head. Bushings have approximately 12″ creepage distance. The recloser will also be available with 15″ creepage-distance bushings where desired.

Get The Whole Story On L-M's Kyle Reclosers and Sectionalizers

L-M offers the most complete line of reclosers—single- and three-phase—from substation to load. Ask your L-M Field Engineer for information and bulletins on Kyle apparatus and complete coordination. Or write Line Material Industries, Milwaukee 1, Wisconsin. In Canada: Canadian Line Materials, Ltd., Toronto 13, Ontario.

Kyle type 6H 3-phase reclosers available in normal load ratings FROM 5 TO 100 AMPERES*

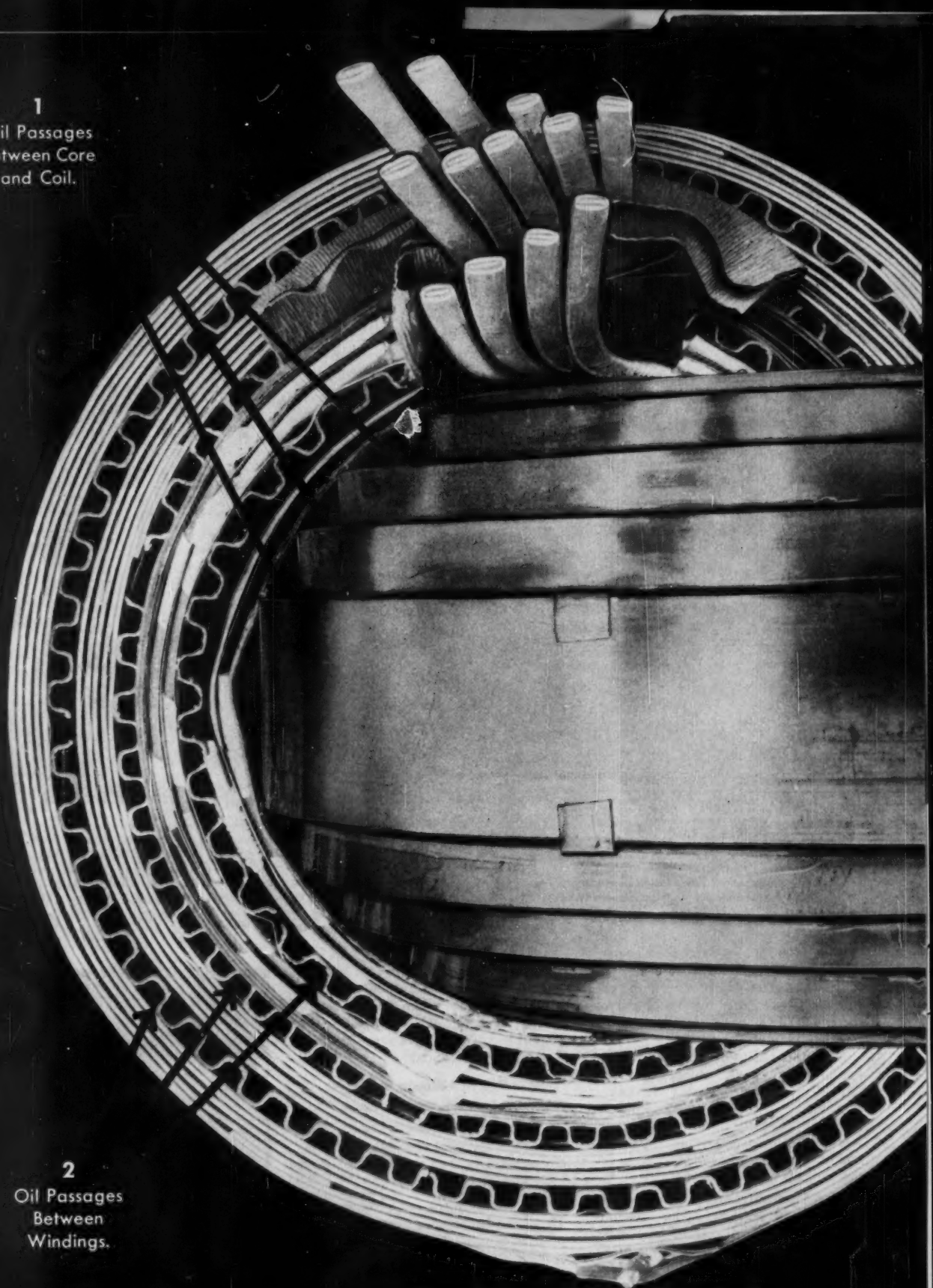
Ratings Amps.	Min. Trip Amps.	Inter. Ratings RMS Amperes 2.4-4.8 kv	Inter. Ratings RMS Amperes 14.4 kv
5	10	200	200
10	20	400	400
15	30	600	600
25	50	1000	1000
35	70	1400	1400
50	100	2000	2000
70	140	3000‡	2000
100	200	3000‡	2000

*Insulation Level: 110 kv BIL.

‡2,500 RMS amperes maximum Inter. rating at 8.32 kv.

Kyle® Reclosers

275-R



L-M Round-Wound transformers have large, unobstructed areas exposed to cooling oil between core and coil (1), between windings and layers (2), and on the outside of the coil. The result is appreciably lower hot-spot temperature—high short-time overload capacity.

Here's Why

L-M's Round-Wound® Core-Coil Design Gives High Performance

By **A. C. WURDACK**
Chief Engineer
Large Distribution Transformers
Line Material Industries

L-M's wound-core, round-coil construction provides the most efficient design for obtaining balanced transformer performance characteristics.

Low Losses

The transformer core consists of a tightly wound, continuous strip of high-grade oriented steel. The core is not cut, unwound, or disturbed in any way after annealing. This results, therefore, in low exciting current, low core loss, and high magnetic efficiency.

Core is wound from strips of steel having several different widths, resulting in a cruciform cross-sectional area approaching an ideal round shape.

L-M's Round-Wound core permits the effective use of a round coil which has a much smaller perimeter than a coil placed around a rectangular core of the same cross-sectional area. L-M's design, therefore, permits smaller turn diameters, resulting in lower impedance and better regulation at all power factors.

High Short-Time Overload Capacity

L-M's Round-Wound transformers have natural oil passages between the cruciform cross-section core and round coil (1) to provide the greatest possible exposure of coil surface area to cooling oil. In addition, duct spacers placed between windings (2) and between layers in most sizes provide additional oil circulation. L-M's core-coil construction, therefore, provides more efficient dissipation of heat from the coils to the oil. The results are lower hot-spot temperatures, and higher overload capacity, or greater over-all life of the transformer.

L-M's round coils are wound directly onto the uncut core. No malleting is required to shape. Long creepage distance between windings and between leads, gives higher impulse strength.

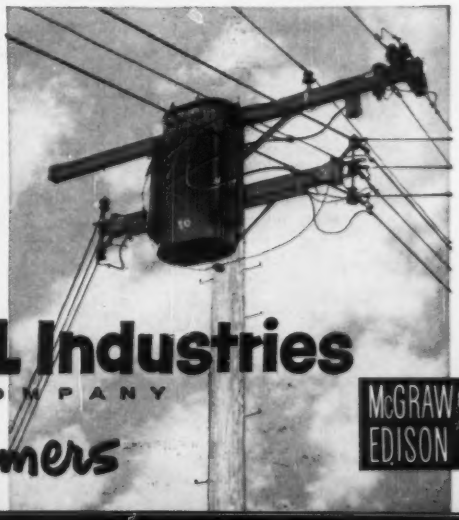
High Short-Circuit Strength

Under short circuits, rectangular coils tend to distort to a round shape, with resultant insulation damage or failure. L-M's round coils are not subject to this distortion when under heavy short-circuit currents, because the coils are already circular in shape. The radial forces are distributed evenly, with little or no effect on the coil. Sturdy clamping structure and varnished coils provide strong mechanical support to prevent axial movement.

Another advantage is L-M's new obround tank design. The transformer is smaller, lighter, and has shorter moment arm distance from the pole.

Get Complete Information

Ask your L-M Field Engineer for complete information on L-M Round-Wound transformers. Or write Line Material Industries, Transformer Division, Zanesville, Ohio.



LINE MATERIAL Industries
McGRAW-EDISON COMPANY
Transformers

McGRAW EDISON

Over ten miles of
used in Shippingport

Testing of Shippingport control system was under way when this photograph was made last summer.

Construction supervisor inspects neoprene-jacketed control cable installed in overhead trays.

neoprene-jacketed cable Atomic Power Station

Atomic reactor replaces coal-fired boilers in the design of this 100,000 kw rated plant. Westinghouse Electric Corporation designed and built the reactor under contract with U. S. Atomic Energy Commission.

Neoprene protects all control cable in first full-scale nuclear power station

There are no second-bests in Duquesne Light Company's new plant. Atomic reaction must be controlled with infinite care, and of course the control cables for this plant are jacketed with neoprene. It was specified as the jacketing material for every foot of the more than ten miles of control cable.

Utilities have had some types of neoprene-jacketed cable in service for more than 20 years. Neoprene's performance makes its specification in the Shippingport plant a logical development.

It resists heat, oil and grease, chemicals and ozone, which deteriorate other types of jacketing. It's also flame resistant. Only neoprene has the combination of properties so useful in electrical applications.

Ask your supplier about wire and cable jacketed with neoprene. It's available in single and multiple conductor types and voltage ratings to meet your requirements. Mail the coupon below to get the ELASTOMERS NOTEBOOK with actual on-the-job reports of neoprene's performance in a wide range of industrial products.

DU PONT

Better things for better living
. . . *through chemistry*

NEOPRENE
— made by Du Pont for 25 years

E. I. du Pont de Nemours & Co. (Inc.)
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Wilmington 98, Delaware

Please put my name on the mailing list for the Elastomers Notebook.

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Firm_____
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City, State_____

MAIL THIS COUPON NOW . . . WHILE YOU'RE THINKING ABOUT IT

New advantages for truck owners introduced in all-new Dodge Power Giants for '58

Power, payload, economy and styling features make Dodge 4-way leaders of low-priced 3

Recent introduction of the new '58 Dodge *Power Giants* brings truck owners a series of the most outstanding advances in Dodge truck's 40-year history.

In power, for instance, Dodge offers three new *Power Giant* V-8's that provide up to 234 hp. . . . as much as 24% more than other low-priced makes. These extra-powered engines can take it easy under normal loads . . . keep going longer, too.

Payload capacities are up to an all-time high. Chassis construction features the elimination of excess weight while actually increasing strength. You get as much as ⅓ more payload capacity.

When it comes to economy, Dodge sweeps the field because of its exclusive Power-Dome V-8 engine design that reduces harmful carbon deposits. This improves gas mileage . . . practically eliminates the need for major engine overhauls.

Dodge styling gives truck owners a real prestige bonus. Striking dual headlights, massive new grilles and luxury cabs are exceptional highlights.

All in all, truck owners would be well advised to check into the '58 *Power Giant* line-up before replacing or adding units. These Dodge trucks are definitely four-way leaders of the low-priced three.

DODGE *PowerGiants*

NEVER BEFORE A PLASTIC TAPE LIKE THIS →

GET TOTAL

new SLIPKNOT #7 ...inseparable fusion

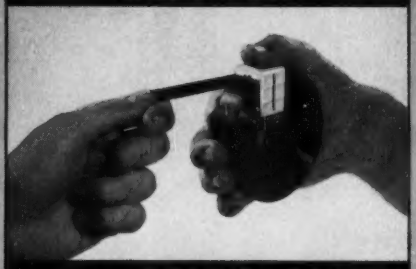
TAPES BY
SOLD ONLY THRU RECOGNIZED WHOLESALERS
PLYMOUTH RUBBER COMPANY, INC.

A COST-CUTTER PACKED IN EVERY CAN!

QUICK, CLEAN CUTS WITH THE NEW SLIPKNOT PLASTIC CUTTER

NOW . . . a new, exclusive, (pat. pending) tape cutter, developed by Plymouth for sure, easy cutting, is packed FREE* in every 66-ft. can . . . to cut without waste, even in the tightest spots! Plastic, non-conducting.

NO MORE OF THIS!



NOW – CUT CLEAN, QUICKLY!

ALWAYS HANDY – PACKS IN CORE!

*Limited time offer

ADHESION

PLASTIC TAPE with ZF-90* for permanent protection

AT LAST . . . a vinyl electrical tape you *know* you can depend on! New SLIPKNOT #7 is superior to any plastic tape you've ever known!

ZF-90* *inseparably fuses* special adhesive to vinyl base; they *cannot come apart*, and therefore *will not dry out. This* is *total adhesion*, making splicing easier, swifter, surer than ever before!

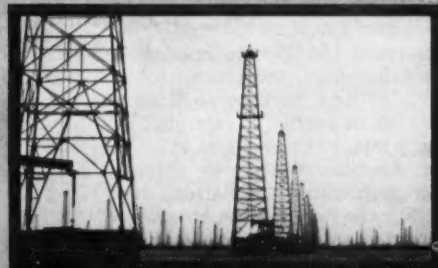
Thus Plymouth creative research has developed a plastic tape that will, with only moderate tension, pull down tightly and hold permanently on *every* job, without creeping or thinning, untroubled by field conditions under which ordinary plastic tapes often fail.

New SLIPKNOT #7 has a wider temperature working range, too, than other plastic tapes. ZF-90* makes the difference. This new tape has successfully passed the most rugged laboratory and field tests ever devised. It will pass all of yours, too.

New SLIPKNOT #7 is tough — abrasion-resistant, yet resilient and easy to handle, *molding totally* around any job. It *permanently* resists the attack of water, acids, alkalies, oils and corrosion. And just *one* .007" layer has a dielectric strength of 10,000 volts!

Why settle for partial protection when you can get *total adhesion* with new SLIPKNOT #7 PLASTIC ELECTRICAL TAPE? Don't wait another day to try it. It's at your distributor's now.

*Plymouth's formula for total adhesion



Temperature, 94°. Humidity, 99%. Electrical conditions — just about the worst in the world! New Slipknot Plastic Tape went to the offshore oil fields of Dutch Guiana — and it's still there, on the job through salt, heat and wet that never let up!

Years of punishment ahead! New slipknot Plastic Tape splices the original wiring in the 'tween-decks of an ocean-going tanker, where salt water and oil will do their worst work! New Slipknot proves its worth on all jobs!

How dry and gritty can you get? New Slipknot Plastic Tape goes to work in the high desert country, where the winds blow constantly! (In wider form, wraps pipelines — its anti-corrosion and abrasion-resistant properties are excellent!)

PLYMOUTH RUBBER COMPANY, INC.

Makers of SLIPKNOT FRICTION TAPE

DIVISION 19 **CANTON, MASSACHUSETTS**

WHAT'S SPECIAL ABOUT LJUNGSTROM®

structural details?

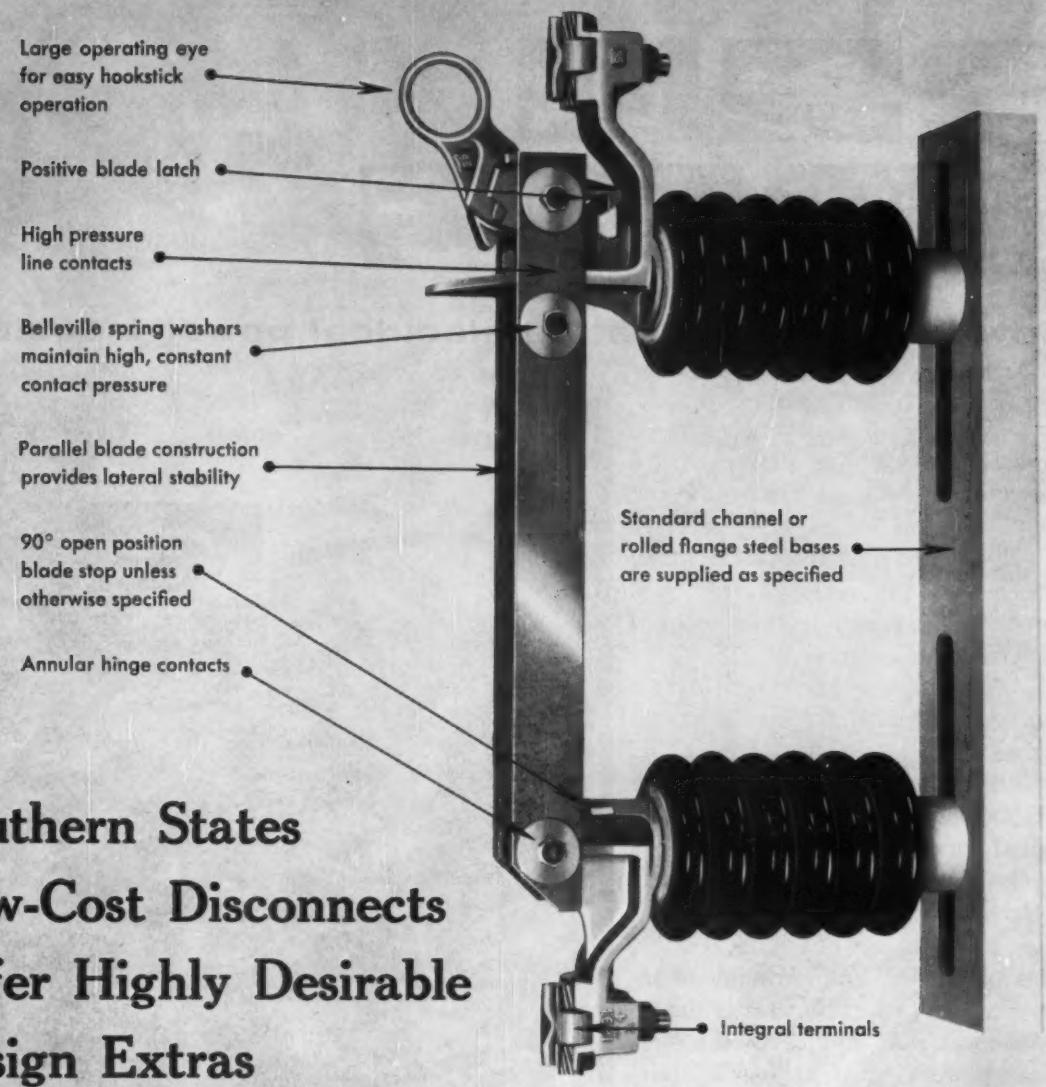
. . . many things.

And all make air preheating with a Ljungstrom more economical, less troublesome. The Ljungstrom offers these refinements:

- The welded steel rotor is strong enough to support the heating elements without strain, yet flexible enough to withstand extreme temperature variations.
- An inspection port and strategically located access doors reveal any maintenance needs and make replacement work routine.
- A mass flow soot blower is installed as original equipment at the cold end where deposits are most apt to accumulate.
- The hot end heating surface is made from open hearth steel sheet and the cold end from heavier gauge, low-alloy corrosion-resisting material because corrosion is normally confined to the cold end.

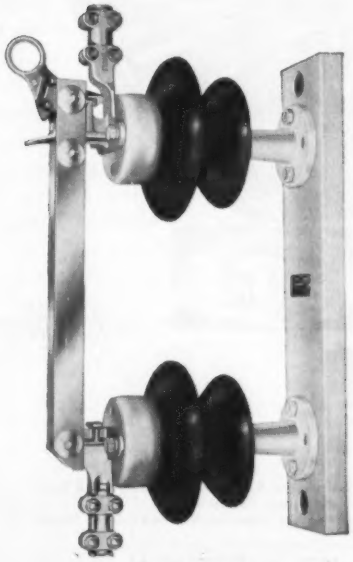
The Air Preheater Corp. is constantly working to improve Ljungstrom heating surfaces, seals, bearings, and other structural details. And, in general, these improvements can be applied to existing units with only minor changes and at nominal cost. Another reason why seven out of ten air preheating installations are Ljungstrom. For the full story on how the Ljungstrom design and construction can cut your fuel costs, increase plant efficiency, write for our 38-page manual.

The Air Preheater Corporation, 60 EAST 42ND STREET, NEW YORK 17, N. Y.


Large operating eye for easy hookstick operation
Positive blade latch
High pressure line contacts
Belleville spring washers maintain high, constant contact pressure
Parallel blade construction provides lateral stability
90° open position blade stop unless otherwise specified
Annular hinge contacts
Standard channel or rolled flange steel bases are supplied as specified
Integral terminals

Southern States Low-Cost Disconnects Offer Highly Desirable Design Extras

TYPE PH



TYPE PHM

As the illustration shows, the Type PH Disconnect has many features usually found on more expensive switches. With these highly desirable design extras available on a low-cost product, it is easy to justify its use on low-revenue distribution lines for isolating, by-passing, or disconnecting.

The Type PHM, shown in the smaller illustration, has all of the features of the Type PH. The only difference is that it has NEMA Standard insulators.

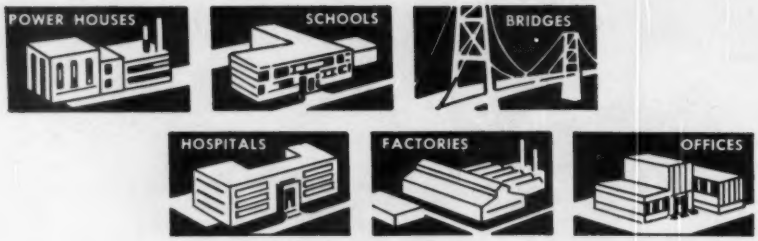
Both switches are single-throw, single-pole, hookstick operated. The PH may be mounted in vertical or underhung positions on wood crossarms. The PHM may be mounted on either steel or wood structures.

Full details will be furnished by your Southern States representative.

Both the PH and PHM are available in 7.5-15 kv, 200, 400, 600 amps. Also available are Southern States PHT and PHMT Tandem Transfer Switches in same ratings.

SOUTHERN STATES
EQUIPMENT CORP.
HAMPTON, GEORGIA

IN CANADA: Dominion Cutout Co., Ltd., Toronto



How INGALLS serves the electrical power industry

One of the big functions of the Ingalls Industries is helping the electrical power industry meet the enormous, rocketing need for power.

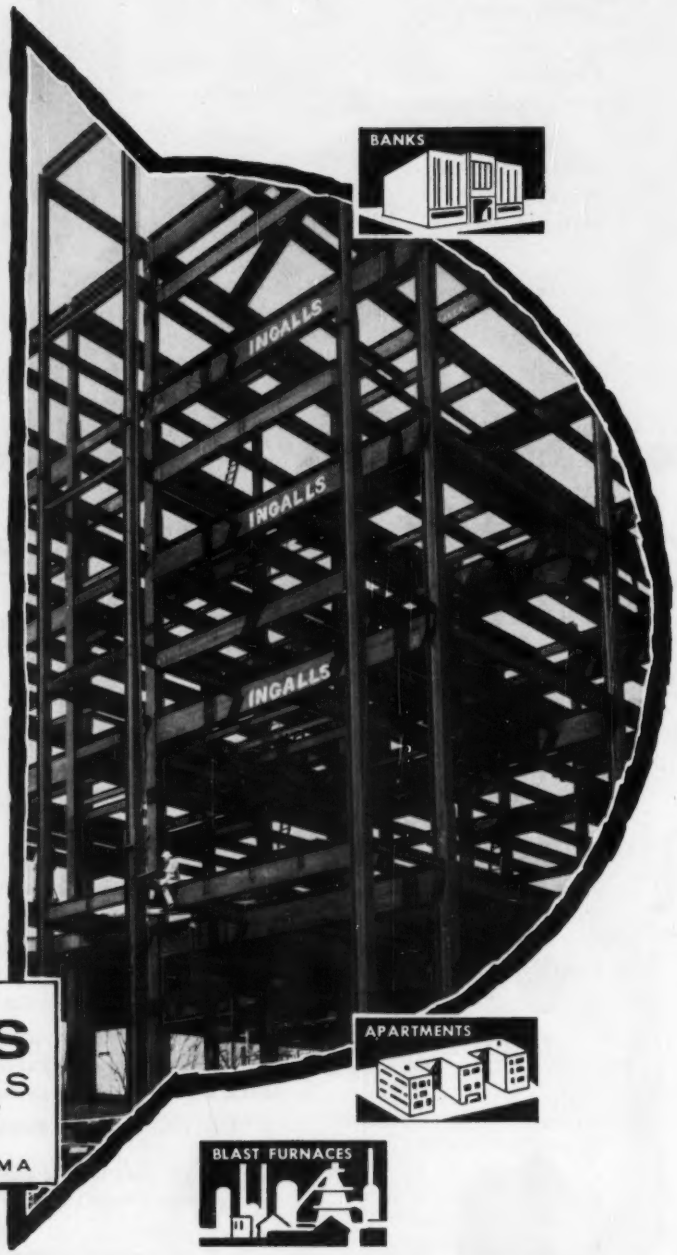
The Ingalls Iron Works Company furnishes the precise fabricated structural steel so essential to modern power plant construction . . .

. . . The Ingalls Steel Construction Company *erects* the steel for power houses . . .

. . . Birmingham Tank Company, a division, furnishes platework and tanks for a wide variety of power house applications.

Each has expanded production facilities, a wide range of technical skills, long experience, and harmony of intra-company effort for faster, more economical steel service to the electrical power industry. Ingalls' outstanding ability has been proved by service in the construction programs of 46 of the nation's leading power companies.

For detailed information or technical assistance, call on Ingalls today.



THE
INGALLS
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BIRMINGHAM, ALABAMA

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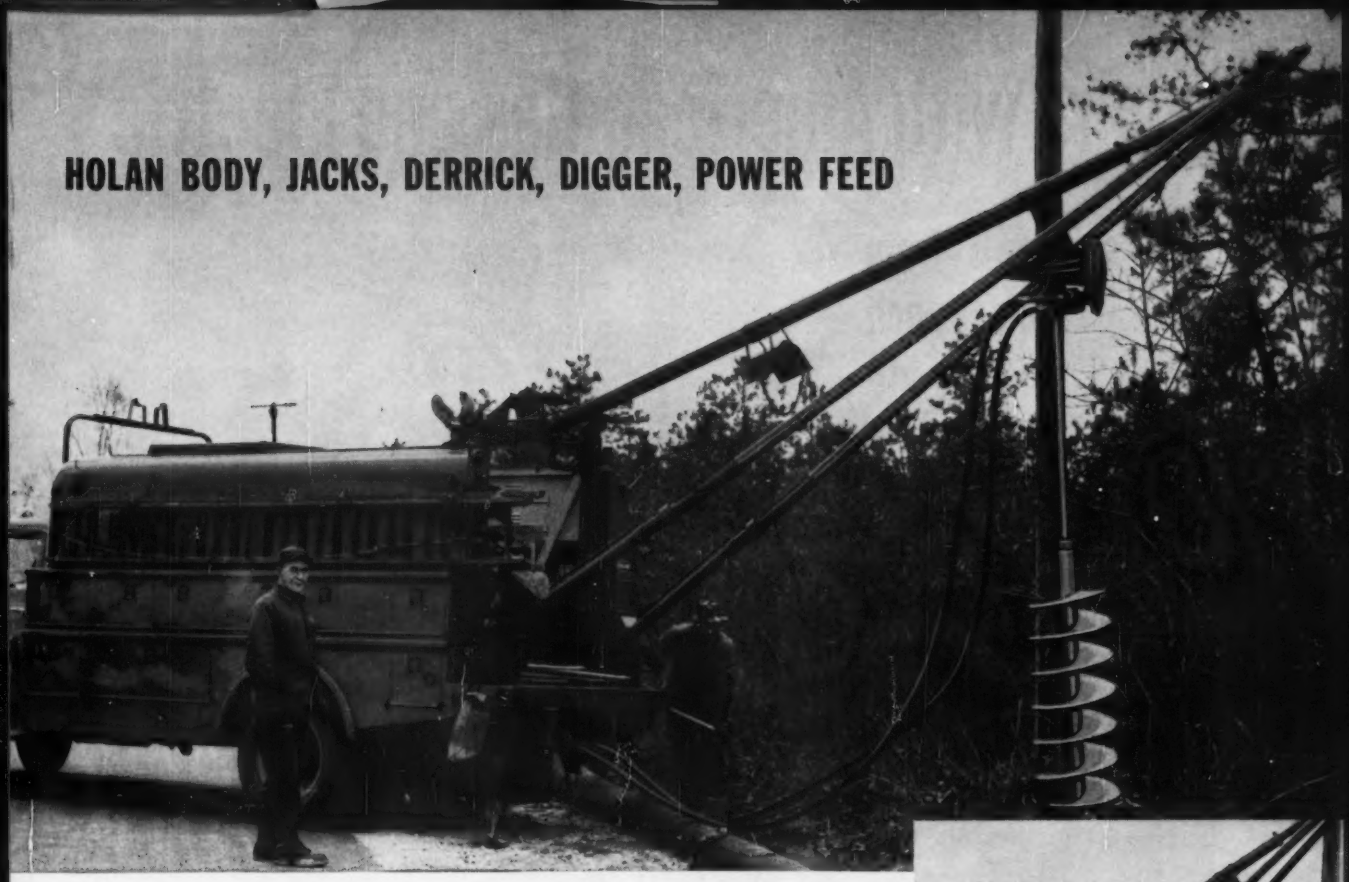
The Ingalls Shipbuilding Corporation, Shipyards: Pascagoula, Mississippi; Decatur, Alabama Sales Offices: New York, Chicago, Philadelphia, Washington, Houston, New Orleans, Atlanta



Dig the hole . . . set the pole

The photos tell the story. This crew is equipped to handle just about any job you give it.

Body: Holan's CHC-182—big enough to carry everything and everybody you need. A 7-man crew compartment plus the usual Holan features such as high-tensile steel throughout, double-panel doors, indented compartment handles and large inside dimensions.

Jacks: Fast-acting, self-stowing, Holan hydraulic jacks move from stowed position to full extension in 8 seconds . . . return in 6 seconds.

Derrick: Holan Series 5700—a live-boom unit with hydraulic sleeve locking for side legs. 6,000-pound capacity . . . 2,000 pounds for loading into truck.

Digger: Holan 4401-H hydraulic earth borer takes the hard work out of hole-digging. Goes down smoothly, pulls up easily, shimmies off dirt.

Power Feed: New bracket-type unit fits onto middle leg . . . uses hydraulic force and weight of derrick to force digger into hard ground . . . holds digger while derrick sets pole.

In other words, whatever you need in bodies and power equipment, you can get from one source: *Holan.* Everything is made of high-tensile steel, everything is a step ahead of the field. Write for catalogs on Holan equipment.

Holan digger shimmies off dirt. Notice digger power feed and sleeve locks on derrick side legs.

Holan power feed attachments can be mounted on Series 3700, 5700 and 6800 derricks. 3700, shown here, has 12,000-pound capacity . . . has been load-tested at 22,000 pounds.

J. H. HOLAN CORPORATION

4100 WEST 150TH STREET
CLEVELAND 11, OHIO

OTHER PLANTS: HOLAN CORPORATION OF GEORGIA, Griffin, Ga.
J. H. HOLAN CORPORATION, PHOENIX DIV., Arizona
BRANTFORD-HOLAN LIMITED, Brantford, Ontario

THE NAME THAT MEANS WORK SIMPLIFICATION

17 years with American Gas and Electric

from Twin Branch in '40 . . .

Twin Branch, Indiana & Michigan Electric Company (Completed 1940)

Philo Plant, Ohio Power Company (Completed 1957)

. . . to Philo in '57

Grinnell has supplied pipe hangers for the following plants of American Gas and Electric System:

Utility	Station	Unit No.	Completion Date
Indiana & Michigan	Twin Branch	3	1940-41
Appalachian Electric	Cabin Creek	8, 9	1942-43
Ohio Power	Philo	4, 5	1941-42
Indiana & Michigan	Twin Branch	4	1944
Ohio Power	Tidd	1, 2	1945-48
Appalachian Electric	Philip Sporn	1	1950
Ohio Power	Philip Sporn	2	1950
Appalachian Electric	Kanawha River	1, 2	1953
Ohio Power	Muskingum River	3, 4	1957
Appalachian Electric	Glen Lyn	6	1957
Ohio Power	Philo	6	1957
Ohio Power	Kammer	1, 2, 3	1958
Appalachian Electric	Clinch River	1, 2	1958

Grinnell Pipe Hangers have met the challenge of skyrocketing pressures and climbing temperatures

Back in 1940, American Gas and Electric Company System made industry history when Unit #3 at the Twin Branch plant of Indiana & Michigan Electric Company went on the line at 2300 psi and 940 F. Grinnell designed the pipe suspension system and supplied the pipe hangers for this pacesetting unit.

In the years that followed, as other AGE stations and units were built, Grinnell continued to serve this progressive utility company. When the supercritical Philo plant of Ohio Power Company was conceived, Grinnell again was selected to engineer the pipe suspension system. Working in an uncharted area of supercritical pressures, Grinnell engineered a system to provide the required safety, and furnished all of the pipe hangers and supports for this 4500 psi — 1150 F steam unit.

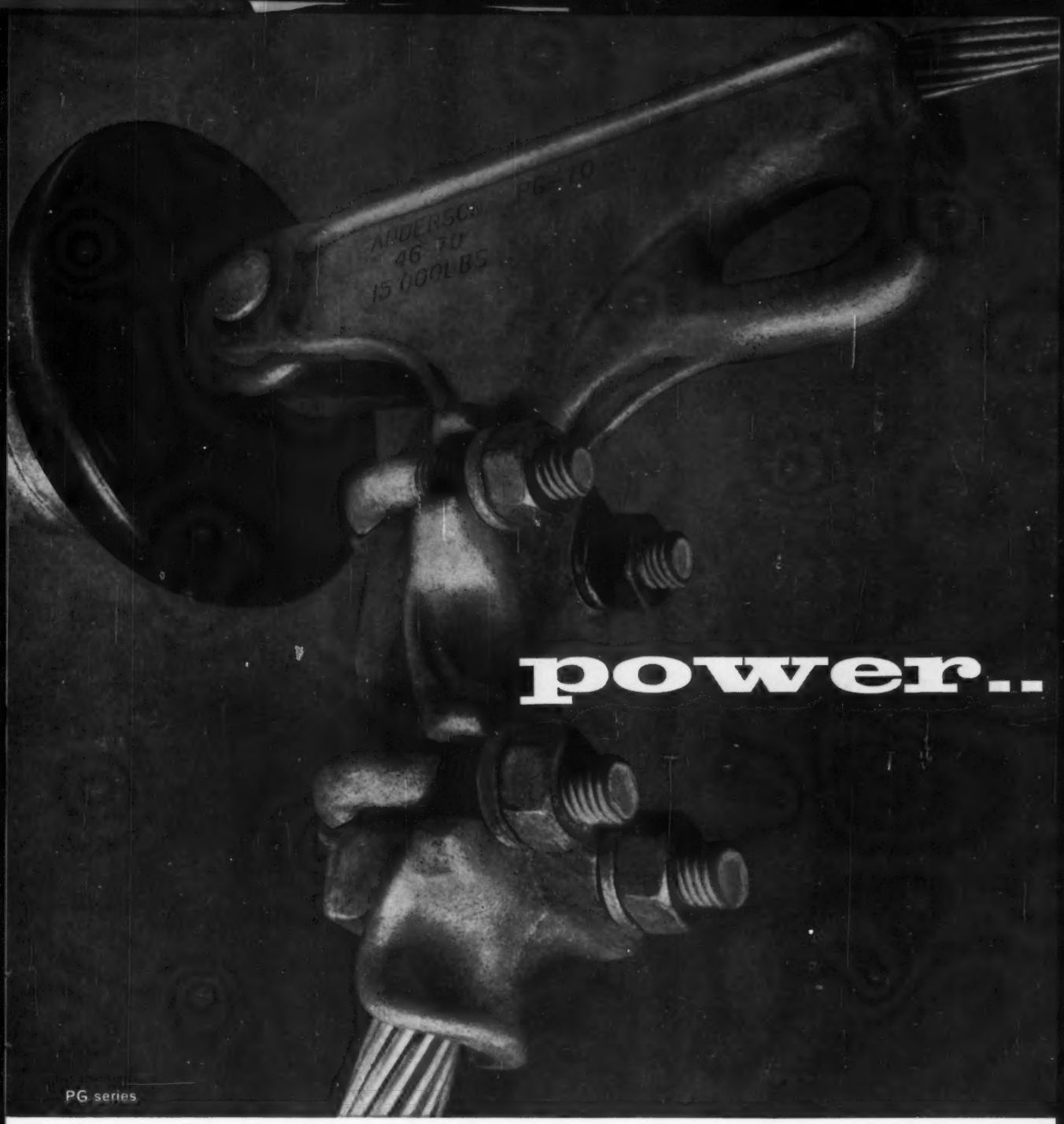
Grinnell invites *your* problems in pipe suspension. Remember, you benefit from more than a century of piping specialization when you call on Grinnell.

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems



ANDERSON ELECTRIC

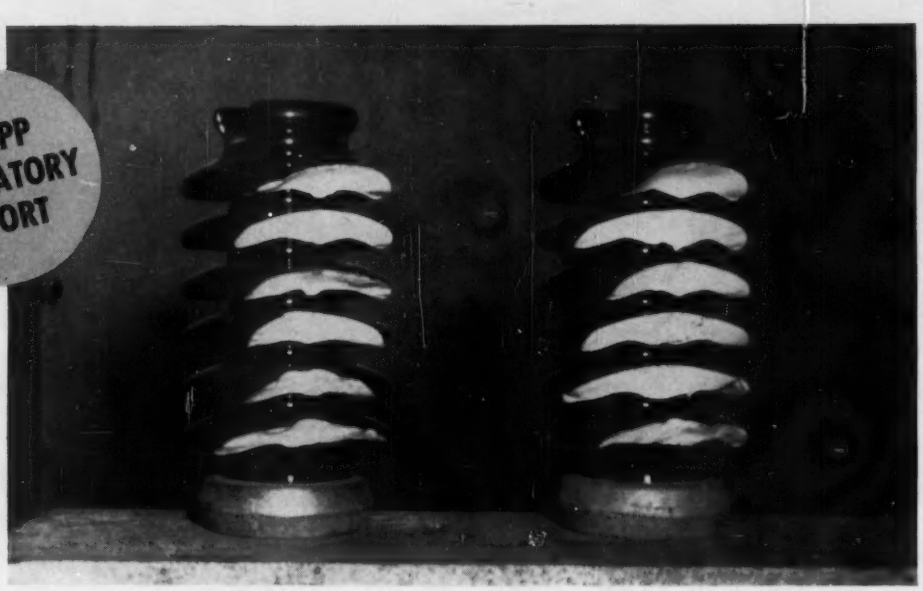
Anderson's Pistol Grip aluminum dead end clamps give top performance on distribution and sub-transmission systems. Snub Seat design assures high holding power. Strong, lightweight aluminum construction reduces cable damage, and one-piece keeper assembly speeds installation.

ANDERSON ELECTRIC CORPORATION
Birmingham 1, Alabama.

Export Representative: International Standard Electric Corp.

Aluminum & Bronze Power Connectors • Clamps • Fittings • Accessories for SUBSTATION • TRANSMISSION • DISTRIBUTION

A LAPP LABORATORY REPORT



BROKEN CORRUGATIONS...

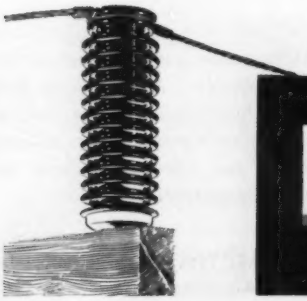
how do they affect performance?

THE PROBLEM: It is well known that mechanical damage to the Lapp Line Post insulator causes much less loss of its electrical characteristics than does such damage to pin-type or suspension insulators. Good maintenance on a system generally does call, however, for changing out insulators that show sign of damage. How urgent is it to replace insulators reported as being damaged? The answer, of course, involves security of the system as well as economy of maintenance, and can be found only in evaluation of characteristics.

THE TEST: Utility engineers whose company operates a large system on Lapp Line Posts wished to set a standard procedure for Line Post maintenance. They visited the Lapp plant and had us make laboratory tests of 35 kv Lapp Line Posts, measuring dry and wet flashover value with petticoats progressively broken off. (We used a hammer to simulate mechanical damage in the field.)

THE FINDING: With the top petticoat broken off, dry flashover was reduced less than 1%, wet flashover by slightly less than 4%. With all six petticoats gone (as shown in the photo) flashover tests showed a loss of 7% in both dry and wet 60-cycle flashover. (In a similar test made previously, we found loss of all corrugations reducing wet flashover somewhat more—apparently the exact pattern of the break has an important effect.)

THE CONCLUSION: The strong post body of the Lapp Line Post remains intact, and an insulator with all petticoats broken will handle normal operating conditions. Loss of one or two corrugations poses no urgency whatsoever. The company for whom this test was made will replace insulators so damaged only when convenient.



Lapp

THE MORAL: Use Lapp Line Posts on your system for distribution and subtransmission up to 88 kv. They'll give you an extra margin of operating security, low maintenance cost and long life.

Lapp Insulator Co., Inc., LeRoy, N. Y.

SURVEYS SHOW that wind, ice, and trees cause nearly three-quarters of all line faults. Protection afforded by Heavy Line Wire's tough thermoplastic covering reduces damage from these sources.

Anaconda Heavy Line Wire defies 3 main causes of line faults

We'd like to report we've found a way to control the wind, ice and trees—the three biggest causes of line faults. Unhappily, we can't. But we can offer you the *next* best thing: Anaconda Heavy Line Wire.

Anaconda Heavy Line Wire has been designed to solve these primary distribution problems – with today's higher voltages in mind.

It's made with a tough thermoplastic covering. This covering has high resistance to moisture, weathering and abrasion. It protects conductors from contact with wet and broken limbs—from damage caused by wind, rain, sleet and snow. There's greater freedom from faults, less pruning needed. You save money. Improve public relations.

Covering consists either of rugged polyethylene or time-tested Anaconda Densheath* vinyl resin compound. Conductors are being supplied in copper, aluminum, and ACSR.

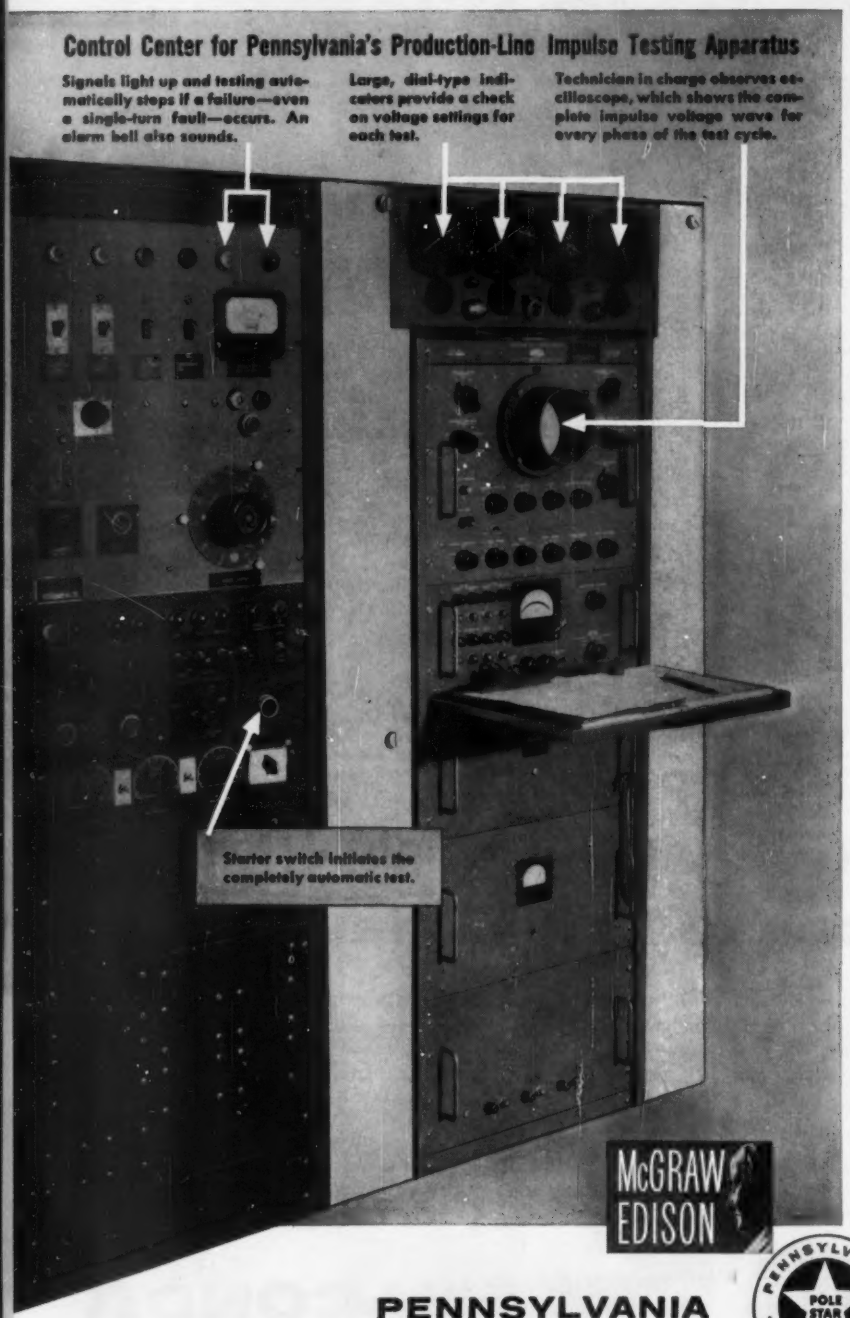
*Reg. U. S. Pat. Off. 58301

NEW BULLETIN DM-5705 contains full information, including sizes, diameters, packaging, plus information on sag and tension charts. See the Man from Anaconda for free copy. Or write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.

LIVE BETTER ELECTRICALLY

SEE THE MAN FROM **ANACONDA®** FOR **HEAVY LINE WIRE**

A Report on IMPULSE TESTING of *Pole Star* DISTRIBUTION TRANSFORMERS


Control Center for Pennsylvania's Production-Line Impulse Testing Apparatus
Signals light up and testing automatically stops if a failure—even a single-turn fault—occurs. An alarm bell also sounds.
Large, dial-type indicators provide a check on voltage settings for each test.
Technician in charge observes oscilloscope, which shows the complete impulse voltage wave for every phase of the test cycle.
Starter switch initiates the completely automatic test.
McGRAW EDISON

- What It Is . . .
- What It Tests . . .
- What It Accomplishes . . .

WHAT UNITS ARE TESTED

All Pole Star distribution transformers from 3 through 167 kva with high voltage ratings through the 18-kv class are impulse tested. The special apparatus used is an integral part of the production line at Pennsylvania Transformer's Canonsburg plant. Both high voltage and low voltage windings are tested.

NATURE AND MAGNITUDE OF THE IMPULSE VOLTAGE

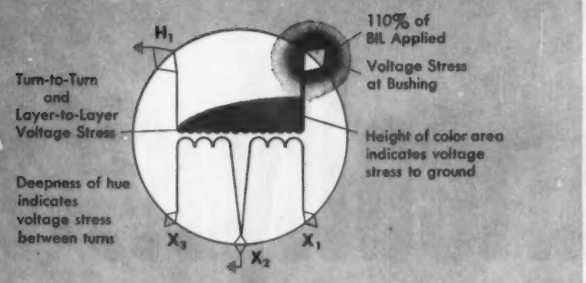
Test voltages applied to the high voltage windings are 10% above the basic impulse level (BIL) values listed in ASA Standards C57.12. The impulse voltage—which is basically the same as the sudden surge that occurs as the result of lightning—rises to crest value in just 1½ microseconds (millionths of a second) and declines to one-half crest value in 40 microseconds.

Because of the low impedance of low voltage windings, a wave of shorter duration is used to simulate more closely the surge effects of natural lightning. Low voltage windings thus are tested at a standard voltage value by applying an impulse voltage with a wave shape of ¾ x 1½ microseconds across one-half of the winding. This induces an equal voltage in the other half, so that twice the applied voltage appears across the total low voltage winding. Simultaneously, an impulse voltage of full BIL value is induced in the high voltage winding.

HOW THE TESTS ARE CONDUCTED

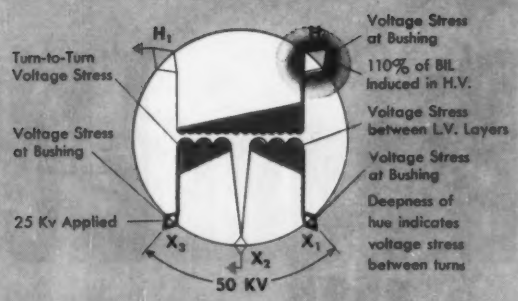
So that the transformer itself will be subjected to the full force of the impulse voltage, both conventional and protected Pole Stars are impulse tested *without arresters* or with arresters rendered inoperative. The tests, which are fully automatic, are conducted in the following manner, with the tank

PENNSYLVANIA POLE STAR TRANSFORMERS DISTRIBUTION



TESTING OF HIGH VOLTAGE WINDINGS

Depicted here is one step in the testing of high voltage windings. In the second step, impulse voltage is applied to H_1 while H_2 is grounded. Test voltages are 10% above the basic impulse levels.



TESTING OF LOW VOLTAGE WINDINGS

Applying impulse voltage in one-half of the low voltage winding induces an equal voltage in the other half. The test also induces an impulse voltage of full BIL value in the high voltage winding.

grounded through a shunt impedance.

For the h.v. winding test, impulse voltage is applied to H_1 while H_2 and X_2 terminals are grounded to the tank. The procedure then is reversed for tests on H_2 while H_1 is grounded.

For the l.v. winding test, impulse voltage is applied to X_1 while H_2 is grounded and a voltage limiting impedance to ground is connected to H_1. The X_2 terminal is grounded and X_3 is ungrounded.

In every phase of the test cycle, the technician in charge observes an oscilloscope that shows the complete impulse voltage wave. Also, an electronic relay is connected so that any failure—even one so minute as a single-turn fault—will automatically stop the testing to indicate the test in which failure occurred.

HOW MUCH OF THE TRANSFORMER IS ACTUALLY TESTED

Traveling at the speed of light, the impulse voltage stresses the turn-to-turn, layer and section-to-section insulation, as well as all insulation to grounded parts, such as the core, core frame and tank. In addition, the impulse voltage fully tests all bushings, leads, tap changers and other accessories. Only transformers that are properly manufactured of highest quality, defect-free material can pass this rigorous test.

WHAT MORE THAN ONE YEAR'S TESTING HAS ACCOMPLISHED

Before production-line impulse testing was initiated at Pennsylvania Transformer, basically the same tests were conducted on Pole Star models and stock units selected at random. This method of testing helped prove the soundness of the Pole Star design, which was further demonstrated throughout the years by Pole Stars' reputation for long-term, trouble-free service.

More than a year-and-a-half of production-line impulse testing, however, has served to make this high quality transformer even *better*. The chief contribution of full-scale impulse testing has been the detection of occasional minor discrepancies—chiefly in component parts but also, from time to time, in certain manufacturing details involving the human element. While these errors are so slight that the units in which they occur have passed *all standard ASA tests* prior to impulse testing, they do represent sources of potential trouble—trouble which may never occur, but which might, in some cases, develop within hours after a transformer is installed.

Of particular significance so far as Pole Star design and construction are concerned is the fact that, during the first full year of testing, actual winding failures occurred in only *one-half of one percent* of the many thousands of transformers tested.

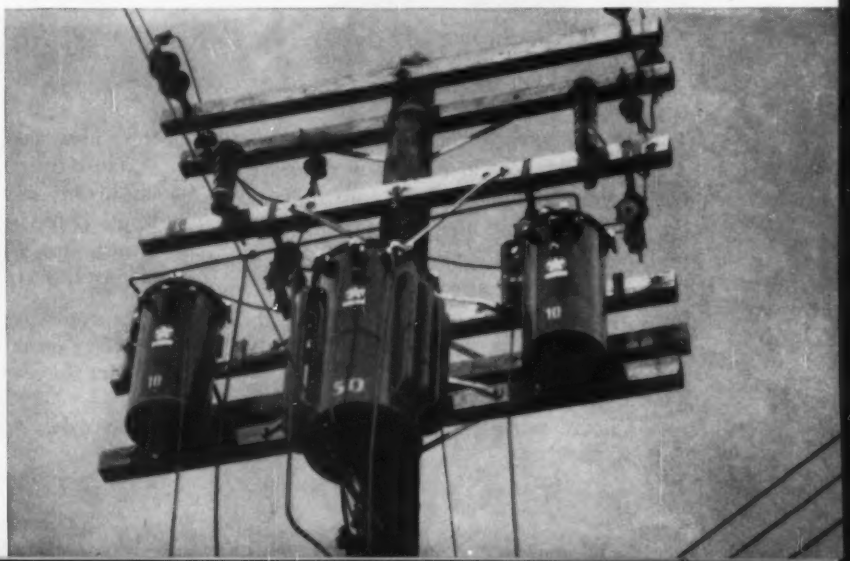
When discovered, *all* causes of failure during impulse testing are attacked with skill and determination by the Pennsylvania engineering and production staffs. Thus far the resulting changes in components (some have been completely redesigned) and improvements in methods have achieved remarkable results. For example, the percentage of rejects for all causes during the last half of the first full year of testing (1.55%) was *over 50% less than for the first six months of the year*. While the rate of percentage reduction may be slower henceforth, production-line impulse testing will continue to safeguard quality, and will be a valuable tool in the hands of production and engineering personnel.

WHAT IT ALL MEANS TO YOU, THE PURCHASER

Even longer average service life than in the past is the principal benefit to be gained by the purchaser of Pole Star distribution transformers as a result of production-line impulse testing. Of course, longer service life means less maintenance, fewer replacements, lower costs—and better service to customers.

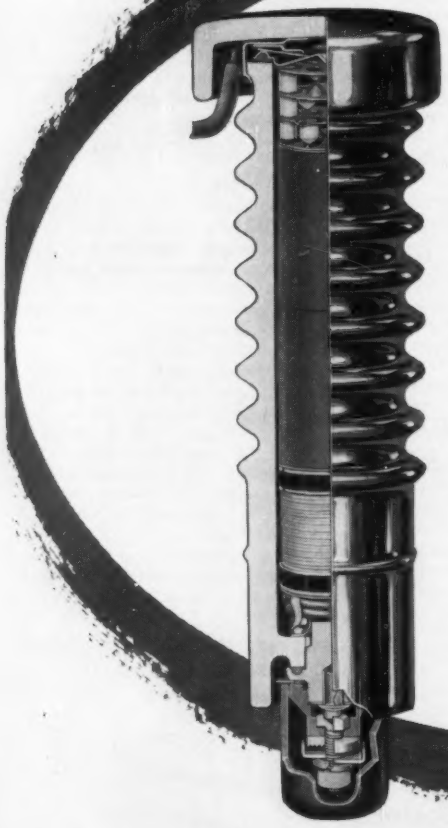
Impulse testing provides a highly efficient and constant check on production methods, component parts, and design effectiveness. Call it "quality control" or by any other name—the net result is that the purchaser *always* gets the outstanding quality and efficiency that are inherent in the Pole Star design. There can be no doubt, too, that the knowledge and experience gained from impulse testing will light the way to an even finer Pole Star of the future.

PENNSYLVANIA TRANSFORMER DIVISION
McGRAW-EDISON COMPANY
Canonsburg, Pa.



TRANSFORMERS

Bigger Electrically...



Inside

Dynagap protective elements are identical, whether used in a 2,400-volt distribution model or a 345,000-volt heavy duty station type. The only basic difference is number.

This imparts to the distribution class -- for the first time -- an entirely new order of durability, plus high sensitivity. The result is a degree of service protection radically new in the distribution field.

Thorex Dynagap distribution arresters offer some entirely new ideas in the protection of both equipment and service continuity. They bring many of the elements of Station Class performance to distribution systems. Never before have interchangeable principal elements been applied to arresters in such widely varying application.

The Dynagap is a major breakthrough in arrester development; transferring the bulk of the valve action away from the valve blocks and into the gap structure, and thus permitting important new techniques in block composition. These are concentrated largely in the direction of vastly increased durability without sacrifice of other functions.

For protection of a new high order -- without a cost premium -- put Thorex Dynagap arresters on your distribution system.

OHIO BRASS COMPANY, MANSFIELD, OHIO

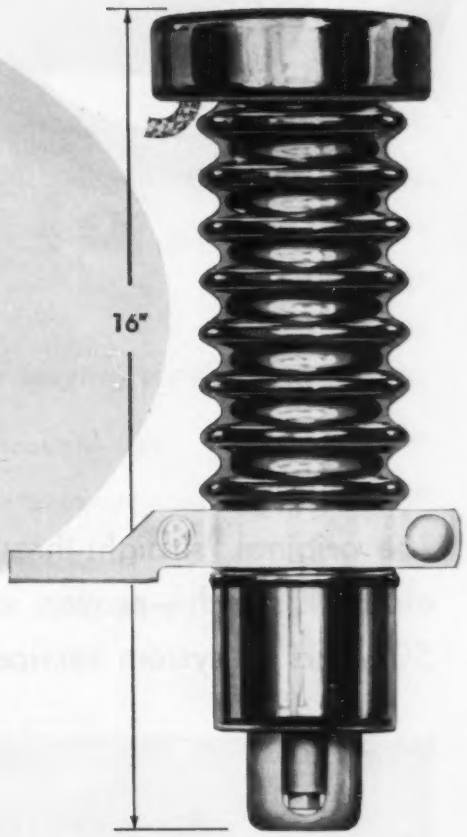
Smaller Mechanically

MORE PROTECTION...BETTER PROTECTION...IS YOURS WITH NEW THOREX DYNAGAP DISTRIBUTION LIGHTNING ARRESTERS

Outside

With its unequalled efficiency and protective ability, the new Dynagap element accomplishes a drastic reduction in size compared to voltage rating.

Dynagap-equipped Thorex distribution arresters are substantially smaller than equivalent types. At the higher voltage range (18 kv) where size is a particular factor, the arrester is approximately one-half the height of some comparable models.

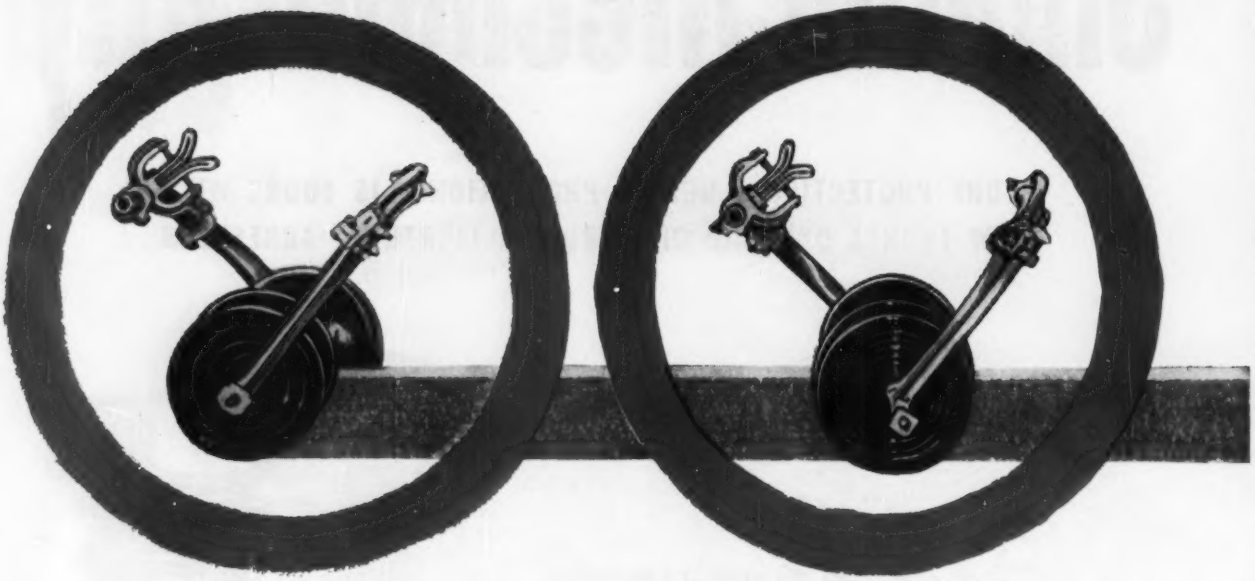


12-KV SIZE

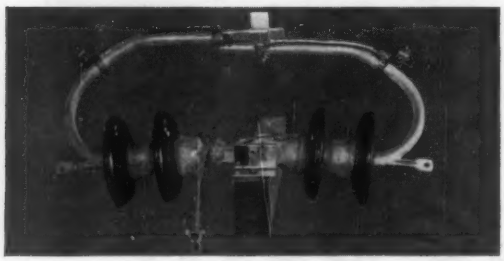
Ohio Brass

4890-H

This "look" on a pole



The original "straight-through" airbreak switch—proven in 50 years of system service



There's no mistaking the exclusive, clean, functional appearance of KPF switches. Their pleasing appearance derives from their simple design—simple design that assures you operating ease in all weather. There are no complicated mechanisms to malfunction, freeze, lock, need lubrication or wear out.

For 50 years, KPF switches have proved their trouble-free service advantages to major power companies. Why not make a test installation on your own lines; see for yourself. More and more companies are. Why not do it this month?

KPF

Write direct for catalog.

means KPF

Some practical reasons for buying KPF Switches

- simplest switches made; trouble-free
- simple manufacturing means lower cost
- no extra dead-end insulators
- installation time half normally needed
- easily installed on hot lines
- install in the air or on the ground
- needs no servicing, year after year!

KPF
AIR BREAK
SWITCHES
Standard for nearly half a century

KPF ELECTRIC COMPANY
Dept. E. 1624 E. Alpine Avenue
Stockton 5, California

4265

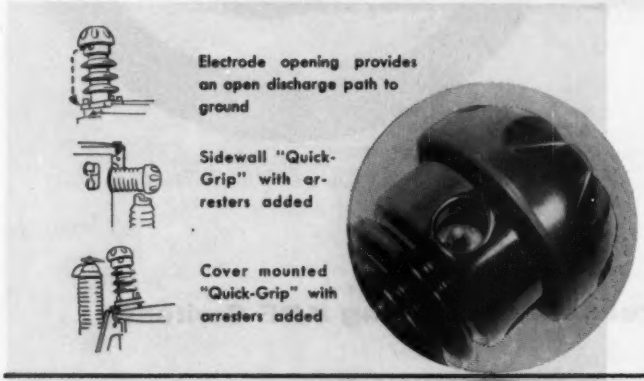
NOW! One Terminal Design

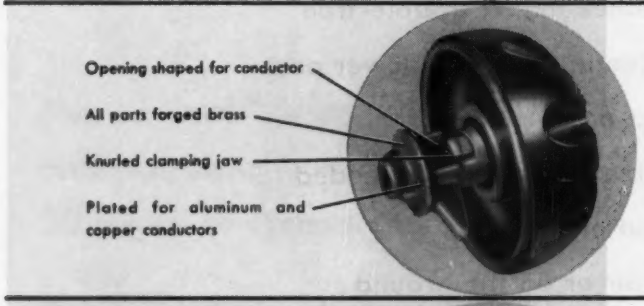
FOR ALL POLE-TYPE TRANSFORMER HIGH VOLTAGE CONNECTIONS

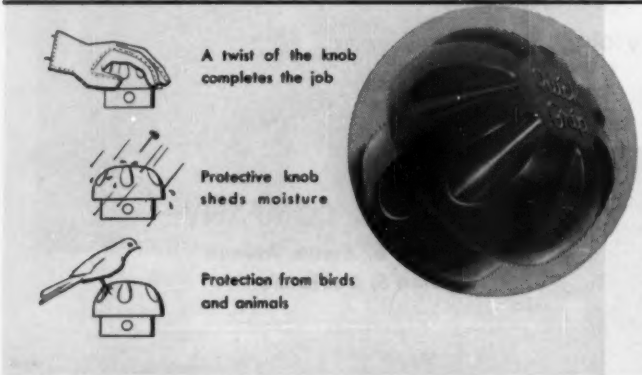
"Quick-Grip" insulated high voltage terminals are standard on all Kuhlman pole-type transformers at no extra cost.

The "Quick-Grip" terminal is by no means new to the industry. First introduced by Kuhlman in 1939, it is universally used today as the fastest, most convenient method for making sidewall line connections. Now Kuhlman, exclusively, offers the same feature in cover mounted designs.

Two years of field service and customer acceptance have proven "Quick-Grip's" versatility in meeting all pole-type transformer high voltage requirements. Here, basically, is how this feature gives all around service and protection for both sidewall and cover mounted bushings.


Electrode opening provides an open discharge path to ground
Sidewall "Quick-Grip" with arresters added
Cover mounted "Quick-Grip" with arresters added





Built-in Electrode

When arresters are mounted on the transformer, "Quick-Grip's" built-in electrode forms a discharge gap to the arrester terminal. When arresters are not physically mounted on the transformer, the electrode can spill over any abnormal discharges to ground without damage to the bushing, assembly, or knob.

Accommodates Aluminum or Copper Conductors

The terminal conductor opening is shaped to minimize cable deformation and provide maximum contact surface. Knurled clamping jaw applies a firm clamp on either solid or stranded wire and compensates for any relaxation in conductor stresses.

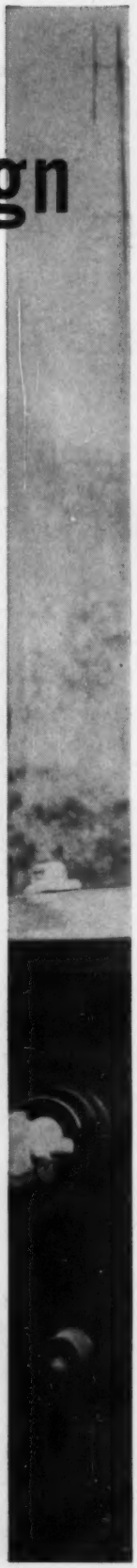
All parts are forged electrical grade bronze to assure greater strength. Clamping parts are plated to eliminate harmful oxidation.

Both cover and sidewall mounted designs accommodate either copper or aluminum conductors.

Greater Convenience, More Protection

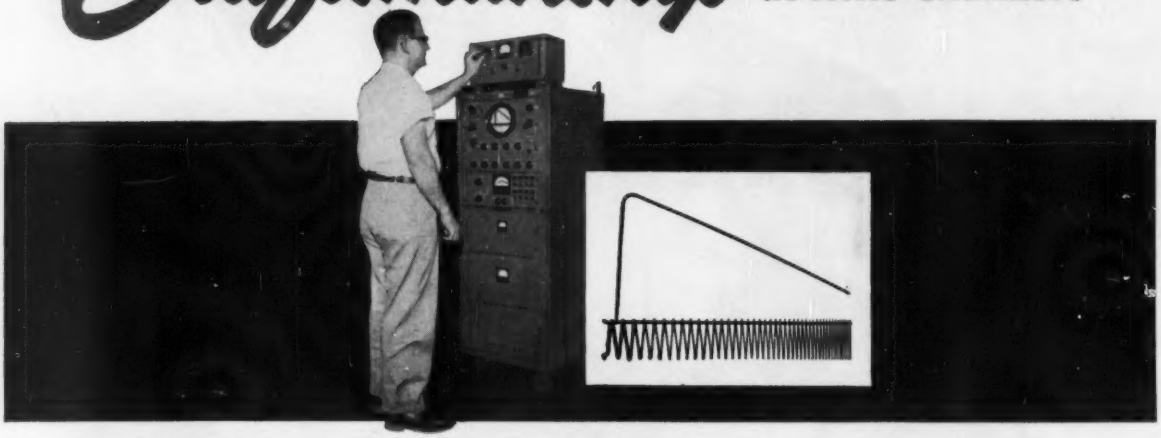
The big convenient hand grip provides an easy, quick means for connecting the line without tools. A permanent connection is simply made by hand-tightening the knob.

The knob's oversize overhang umbrellas the terminal assembly, sheds water, and keeps dirt and moisture away from the terminal parts. It serves as an insulator as well and eliminates accidental outages or flashovers caused by birds and animals coming in contact with the terminals.



KUHLMAN ELECTRIC COMPANY
General Offices: Birmingham, Michigan
BAY CITY, MICHIGAN • CRYSTAL SPRINGS, MISSISSIPPI • SALINAS, CALIFORNIA

Craftsmanship at Allis-Chalmers



Automatic Fault Detector Improves...

Impulse Testing

of Distribution Transformers

The new Automatic Fault Detector, used by Allis-Chalmers, minimizes chance for human error in impulse testing of distribution transformers... adds assurance that the overall strength of insulation meets all standards. The fault detector signals the impulse test operator with a ringing bell and flashing red light. Combining automatic fault detection with an experienced tester's visual inspection of the *oscilloscope* assures that even the smallest fault will be revealed. Liquid filled distribution transformers from 3 to 500 kva are impulse tested by Allis-Chalmers.

Production-Line Impulse Testing Originated by Allis-Chalmers

Ten years ago Allis-Chalmers initiated impulse testing for pole type distribution transformers. Expanded to embrace all distribution transformers, the program includes both conventional and self-protecting designs.

This Allis-Chalmers quality control check is assurance that the transformer insulation can withstand severe lightning and surge conditions. It has resulted in an enviable operating reliability record, especially in areas of heavy lightning concentration.

For the complete craftsmanship story contact your A-C representative, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-5559

Editorial Comment

JANUARY 13, 1958

Pioneers at Shippingport Can Be Proud

At Shippingport, Pennsylvania today, the first big atomic power plant designed to produce electric energy for peaceful human consumption is in operation. It is an accomplishment of which the men of Duquesne Light Co, Westinghouse and the Atomic Energy Commission and the utility industry may be justly proud.

Pride in this achievement, which was carried out on schedule, according to plan and unmarred by accident, is not dulled in the least by the fact that it is neither the first atomic plant in the U. S. to produce electricity nor the largest in the world. Britain's gas-cooled production reactor at Calder Hall has been in operation for some time.

For Shippingport was not built to break records, or to be competitive with other fuels or even to be an economic endeavor. The principle purpose of Shippingport was to develop and perfect our knowledge and understanding of reactors and their application to power generation.

We are a long way from knowing all we need to know about atomic power and the relative feasibility of various types of reactors in large scale power generation. Someone had to make a start, to be willing, even eager to take risks so that the promise of peaceful power from the atom can come true in our time for all men.

Shippingport is that beginning. And it is in their willingness to begin and to back their faith in the future of economic nuclear power with action that the industry and the men responsible for Shippingport may take justifiable pride.

Our Battle Is For the Minds of Youth!

Stung by the scientific embarrassment of the Sputniks, it would be easy for the United States to be panicked, today, into an educational program to mass-produce scientists. This would be a mistake!

Our need today is not to mass-produce technical mediocrity. It is to attract to the science and engineering the best young minds of our time and so achieve scientific and technical strength.

This view has been expressed by no less an authority than Dr James R. Killian, newly-appointed Special Presidential Assistant for Science and Technology. He put it this way in an address before the Society for the Advancement of Science:

"I hope we do not set as our goal an academic numbers race with the Russians . . . If American science is to continue to prosper, if it is to attract the proper complement of creative and gifted minds, we must combat the notions that science and engineering are . . . narrowly materialistic and destructive of human values.

"Science and engineering are a major means for 'making gentle the life of mankind'. If science can appear in its true colors and thus be recognized, we will have accomplished the major requirements for attracting *enough* first rate minds into science, and for maintaining a vigorous, advancing technology."

Thus America faces the task of inspiring its youth; of restoring in them admiration, respect and emulation for the high calling of the scientist, the engineer and the educator, and so set the best of our bright new minds seeking the path of enlightenment.

We will have succeeded when the search for truth outshines the pursuit of personal profit, when scholarship outranks conquest, and when the dedication, humility, and dignity of scientific endeavor are restored to public esteem.

Winter Peak Falls Below Estimate

Company	1957 Winter Peak Load Kw	Increase Over 1956-7 Winter Peak Kw	%	% Over Predicted Winter Peak	% Over 1957 Summer Peak
Alabama Power Co	1,406,400	113,400	8.77	−4.3	−10.8
American Gas & Electric System	3,951,000	206,000	5.5	−4.8	4.0
Atlantic City Electric Co	259,300	19,800	8.3	−1.4	− 3.3
Arizona Public Service Co	336,800	49,500	17.2	4.0	−31.2
Baltimore Gas & Electric Co	931,000	36,000	4.0	−2.3	− 6.7
Boston Edison Co	829,375	5,622	0.7	−9.0	12.7
Brockton Edison Co	77,680	1,880	2.5	−7.5	24.2
California Electric Power Co	204,800	8,300	4.2	−9.0	−21.3
Carolina Power & Light Co	972,000	52,000	5.7	−3.2	3.5
Central Hudson Gas & Elec. Corp	210,300	380	0.2	−9.2	4.3
Central Vermont Public Service Corp	80,000	−5.500	−4.0	−5.3	9.3
Cleveland Electric Illuminating Co	1,278,000	18,000	1.4	−1.3	0.7
Commonwealth Edison Co	3,774,000	40,000	1.1	−2.6	−1.5
Connecticut Light & Power Co	674,934	−4,978	−0.7	−8.0	12.9
Consolidated Edison Co	3,336,000	53,000	1.6	−2.6	− 3.6
Consumers Power Co	1,632,005	61,185	3.9	−6.7	6.0
Dallas Power & Light Co	371,700	26,800	7.8	−2.2	−45.8
Delaware Power & Light Co	302,400	10,300	3.5	−7.6	− 8.6
Detroit Edison Co	2,546,000	71,000	2.8	−7.4	5.1
Duke Power Co	2,147,480	78,255	3.8	−4.3	−1.4
Duquesne Light Co	1,190,500	−28,300	−2.5	−3.5	2.4
EEInc & OVEC	3,116,500	−99,000	−3.1	2.1	− 1.0
Florida Power & Light Co	1,134,500	155,000	15.9	−0.4	26.8
Florida Power Corp*	546,000	−21,600	−3.8	−0.5	36.5
General Public Utilities	1,810,700	91,800	5.3	−4.1	7.8
Georgia Power Co	1,847,000	142,180	8.3	−0.2	− 4.7
Hartford Elec Light—Conn Power Co	329,100	7,000	2.2	−7.9	15.4
Kansas City Power & Light Co	523,000	9,000	1.8	−2.6	−26.6
Kansas Gas & Electric Co	338,600	13,500	4.2	−9.5	−22.7
Long Island Lighting Co	814,000	43,800	5.7	−7.0	20.2
Los Angeles Dept Water & Power	1,346,000	66,000	5.2	−1.8	17.7
Louisiana Power & Light Co	335,000	16,071	5.3	−4.8	−20.2
New England Electric System	1,260,000	19,000	1.5	−3.1	15.9
New Orleans Public Service Inc	229,000	−2,000	−0.9	−3.8	−33.0
N. Y. State Electric & Gas Corp	768,000	40,000	5.5	−2.4	18.2
Niagara Mohawk Power Corp	2,679,700	−67,200	−2.4	−8.2	9.9
Northern States Power Co	1,234,262	62,767	5.3	2.4	9.5
Ohio Edison System	1,446,800	18,800	1.3	.....	5.0
Oklahoma Gas & Electric Co	470,600	28,100	6.3	−1.4	−27.1
Pacific Gas & Electric Co	3,906,400	206,500	5.6	−2.1	− 4.3
Pacific Power & Light Co	809,000	−36,000	−4.3	−7.2	21.9
Pennsylvania Power & Light Co	1,237,000	33,000	2.7	−3.5	2.6
Philadelphia Electric Co	2,224,000	56,000	2.6	−4.5	− 4.0
Portland General Electric Co	754,000	−25,000	−3.2	−4.3	−28.4
Potomac Electric Power Co	776,000	62,000	8.7	1.8	−19.6
Public Service Co of N. H	261,900	5,500	2.1	−9.7	5.6
Public Service Electric & Gas Co	2,170,000	109,000	5.3	−5.2	− 4.5
Puget Sound Power & Light Co	523,000	−9,000	−1.7	−2.0	.....
Rochester Gas & Electric Corp	341,400	9,000	2.7	−3.6	9.7
Salt River Power District	161,300	6,000	3.9	−4.0	−36.5
Southern California Edison Co	2,632,800	128,800	5.1	−3.6	2.9
Southwestern Gas & Electric Co	306,300	15,800	5.4	−1.2	−28.5
Southwestern Public Service Co	497,000	66,000	15.3	1.2	−16.8
Tacoma City Light Dept	361,000	−12,000	−3.2	−16.8	20.7
Tennessee Valley Authority	9,339,000	100,000	1.1	0.4	16.3
Union Electric Co	1,270,000	45,000	3.7	−2.6	−16.4
United Illuminating Co	322,750	−4,400	−1.3	−4.5	5.4
Utah Power & Light Co	545,700	19,400	3.7	−7.5	12.9
Virginia Electric & Power Co	1,307,000	79,000	6.4	−5.3	−2.0
Washington Water Power Co	565,000	−30,000	−5.0	−8.0	21.0
West Penn Electric System	1,505,000	−14,000	−0.9	−5.4	3.3
Western Mass Electric Co	257,600	13,500	5.5	1.0	11.2
	78,813,586	2,162,162	2.8	−3.1	1.7

*Includes load of subsidiary for 1956-7 peak but not for 1957 peak.

88 utilities tell EW that only 8% exceeded peak load estimates. Seven major companies have peaks below previous summer peaks

Above-normal temperatures during the pre-Christmas peak-load period and a decline in industrial activity were in back of the general failure of utility winter peak loads to reach estimates. Only 8% of the utilities recorded winter peaks above their estimates. However, most of the industry experienced peaks which exceeded 1956-7 winter peaks.

Summer Peaks Higher

The full effect of mild weather and industrial softness was felt by seven utilities of one-million kw or more. The two factors combined to hold their winter peaks below previous summer peaks, while 70% of the utilities reported winter peaks above the 1957 summer peak loads. Continued mild winter weather plus growing comfort-cooling load will hasten the trend toward system summer peaks. As a result of peak loads this winter, four major companies along the East Coast expect to join the ranks of summer-peak-load systems this year.

This round-up of winter peak data is based on an informal Electrical World survey of 88 Class I utilities which reported non-coincident peaks totaling 78,813,586 kw. This peak represents an increase of 2,162,162 kw, or 2.8% above the corresponding previous winter peak. The total peak figure was about 97% of the sum of individual peak load estimates, and was only 1.7% above the aggregate of 1957 summer peak loads.

Represents 74% of Capacity

The 88 utilities in the survey account for about 74% of the total installed capacity in this country. Extending the survey result of 2.8% above the previous winter peak to all Class I utilities gives an increase of 2,870,000 kw based on 1956-7 winter peak of 102,444,000 kw.

Thus, the 1957 winter peak corresponding to all Class I operations is indicated as 105,314,000 kw.

Almost all peak loads reported occurred from Dec. 8 to 21, although five companies had peaks in November. Mild temperatures were experienced by at least 27 companies during the customary pre-Christmas peak-load period. Five utilities in the South, Mountain states, and Pacific Northwest said they expect their 1957-8 winter peak after the first of the year. Several of these customarily have their winter peak after Jan. 1. One company noted that its below-estimate peak, when corrected for temperature, still represents a 7% load growth trend.

Industrial Load Off

Citing the other major cause of lowered peaks, one company said "unsteadiness in industrial business and conservative rates at which new loads are being brought up to ratings" held its peak down. From different parts of the country came 20 expressions such as "a weakening in general business conditions" and "a decline in industrial use." Mentioned specifically were cutbacks in steel production, textiles, machine tools, and the metals industries.

For the first time, reported Commonwealth Edison Co, the system winter peak load in the Chicago area was lower (1.5%) than the summer peak of the same year. Lower winter than summer peaks also were reported by Baltimore Gas & Electric Co, Consolidated Edison Co, Delaware Power & Light Co, Duke Power Co, Philadelphia Electric Co, Public Service Electric & Gas Co, and Virginia Electric & Power Co. These eight utilities normally are considered winter-peak systems.

Peak Still to Come

Consolidated Edison's winter peak was affected adversely by a subway strike in New York City during the worst weather in December. This period is normally the heaviest shopping season of the year. For the other companies it was mild weather and industrial load drop-off. A few expressed confidence that colder weather in January will bring winter peaks up to estimates and above previous summer peak loads.

Hoosier Loan Stirs Comment

$42 million may not be enough for G&T plan. One 'quick estimate' hits $50 million. Firm arrangement with industrial company unlikely for six months at least

A new flurry of conversation has been stirred up by the announcement that Hoosier Cooperative Energy Inc of Indiana may increase its $42-million loan application now pending before the Rural Electrification Administration in Washington.

If Hoosier gets the loan it seeks, it plans to build a 198-Mw steam station and about 868 miles of transmission lines. This generating and transmission system would serve nine Indiana rural electric co-ops that now buy power from private utilities in Indiana.

R. A. Gallagher, president of Public Service Co of Indiana, said he felt the $42-million figure was too low for the project described in Hoosier's original application. Gallagher said his company's "quick estimate" was "at least $50 million."

Originally it was understood that REA was being asked to supply $42 million as a federal loan, and that $3 million would come from another source—Richards & Associates of Carrollton, Ga. Under the original plan, Richards & Associates was to take a steady 55 Mw at an aluminum reduction plant it would build 55 miles away in Kentucky. It was also reported that Richards & Associates was to lease the proposed power plant, and that Pres Roy Richards had written a letter of intent to REA.

Plant Site Not Firm

It is now understood from a reliable source that Richards & Associates is considering other areas, some served by private utilities, for its proposed aluminum plant—particularly in the lower Mississippi Valley. It is understood that the company is running an engineering study to determine which site best suits its needs, and that this engineering study will not be complete for six to 12 months. The company now gets all of its power from Georgia Power Co.

Meanwhile, Frank Ratts, mayor of Osgood, Ind., and coordinator for the Hoosier project, states that the leasing arrangement has been changed. "We felt it advisable to sell (Richards) surplus power until load growth called for capacity increases," Ratts said.

Gallagher said he thought it unlikely that any aluminum company would want to build a plant in an area if only surplus power were available.

Would Put in Own Unit

A booklet published by the Carroll County Rural Electric Membership Corp, however, said "Richards & Associates will, under contract, invest $12 million of their own money in a fourth 66,000-kw unit" when the Hoosier system requires close to the full use of two generators for firm capacity.

On another front, Indianapolis Power & Light Co's Pres Ottis Fitzwater said Indiana legislators indicate that the Hoosier loan application has been "stopped." He said Sens Homer Capehart and William Jenner and Congressman Charles B. Brownson have expressed this view.

Commenting on the possibility that Richards & Associates may build its plant elsewhere, Fitzwater said, "I don't see how the REMC's could support a plant without industrial load in the area."

The nine member co-ops have a present total load of 42 Mw. Public Service Co of Indiana supplies power wholesale to eight of the nine. The Hoosier group asserts that its proposed plant will yield savings in power costs over what the co-ops now pay private utilities.

New Co-op Set-Up a Possibility

Mayor Ratts told EW that he believes the Hoosier group would seriously study setting up a different organization if REA fails to approve the loan.

Meanwhile in Washington, REA says it has nothing new to report on the Hoosier application except that it is "still in the works."

Public Works Push Grows

Soviet water resources development exceeds missile and satellite performance, Straus (right) says. Vigorous U. S. program sought

The Senate Interior Committee has fired another round in the battle to hold the line on federal public works programs.

Chairman James E. Murray (D-Mont.) made public a promised report by Committee Consultant Michael W. Straus, former reclamation commissioner, on Soviet water resource development. The document pulls together available factual data to show that Russia and Red China are pushing their hydropower, water transport, flood storage and irrigation programs at a rate that is rapidly strengthening their economic and industrial base *vis a vis* the United States.

In fact, Straus declares, the communist efforts in water development "exceed in volume all their missile and satellite performances." His report makes the point that Red gains in harnessing of water resources are steadily increasing the relative strength of the totalitarian governments for waging either a long cold war or an all-out military struggle. At the same time, federal programs in the U. S. have been slowed down.

The Senate report supplies additional ammunition to the water development forces that oppose any further retrenchment in U. S. water projects for fiscal 1959. Since last summer, the National Rivers and Harbors Congress has been sounding the alarm on Russian advances and calling for vigorous promotion of U. S. programs. The Army Engineers last month stressed the same theme in a speech by Maj Gen Emerson C. Itschner, chief of engineers.

In rate of development, expressed as percentage of increase per year in developed resources, the communist programs are outstripping ours in all four fields of water resources utilization, the Straus report shows. But, in absolute terms of capacity in existence or added each year, the U. S. still holds a big lead in most departments except irrigated acreage and annual hydro-power growth.

Last week, the National Rivers and Harbors Congress called for an advanced program of expansion of water resources to meet the challenge of the new space age. Rep Overton Brooks (D-La.), president of the Congress, said that the U. S. can afford both an adequate space age defense and an expanded program of internal development.

Chudoff's Exit Puts Alabamian in House Line

Rep Earl Chudoff (D-Pa.), well known for his investigations of the electric companies and the administration's power policies, is resigning from Congress to become a judge in Philadelphia.

Dem Robert E. Jones, a strong federal power backer of Alabama, is senior member of the House subcommittee which Chudoff headed.

Chudoff sprang into prominence as far as the electric industry is concerned in 1956 when, as chairman of the Public Works and Resources Subcomittee of the House Government Operations Committee, he conducted a series of hearings throughout the country on how administration policies were affecting the operations of the various government power agencies.

Chudoff subsequently issued a report charging the administration with working hand in glove with private power companies to the disadvantage of the electric co-ops and with attempting to dismember such federal power agencies as the Bonneville Power Administration.

Minority members of the committee denied the charges with equal vehemence and in turn accused Chudoff of issuing a biased, distorted report.

Much the same situation arose when Chudoff later investigated the activities of a Rocky Mountain group of electric companies in issuing two pamphlets directed against the growth of federal power.

As a result of this hearing Chudoff requested the Federal Power Commission to investigate the manner in which a number of electric companies had charged the pamphlets in their accounts. FPC found that the pamphlets were incorrectly charged in most cases.

Argonne Reactor Gives 1,250-Kw Dividend

Operating level is boosted to 6,500 kw, slashing power costs by 1/3. Further power capacity improvements expected

A ray of sunshine has been brought into the unhappy nuclear power economics picture by the performance of the Atomic Energy Commission's experimental boiling water reactor (EBWR) at the Argonne National Laboratory.

Argonne scientists have found that they can step up the operating power level far beyond the level the reactor was designed for. Thus, they can reduce the cost of power produced by the plant by one-third.

Furthermore, they are now confident that with minor modifications the power level of the reactor can be even further improved.

EBWR was designed to produce 20,000 kw of heat and 5,000 kw of electricity. After 10 months of experimentation, Argonne was able to step up the heat output to 50,000 kw but electric power output could be increased only to 6,250 kw because of the size limitation of the existing generator. Calculations at Argonne indicate that heat output can be increased to 100,000 kw and electrical output to 25,000 kw.

Hope for 10-Mill Power

Theoretically, the present achievements mean a reduction in cost of power from 52 mills/kwhr to 32 mills. The cost could be reduced to 20 mills with the present plant, and scientists believe 10 mill power is possible within about 10 years.

The improvement in performance of EBWR was not entirely a surprise to AEC scientists. They had known previously that there was a possibility that this improvement could be achieved, but they did not know just how far they could go.

Commenting on the accomplishment, Dr Bernard I. Spinrad, director of Argonne Reactor Engineering Division, said he believes EBWR is the "least expensive to operate of the power reactors" now being developed in AEC's civilian power reactor program.

The reactor was designed so that the 114 fuel element loading would operate at design power output with the control rods partly removed.

After the reactor had been completed and put in operations, oscillator tests showed that it would be safe at double the design output.

Thus, without changing the core loading, and merely by withdrawing the control rods further, the improved performance was obtained.

Withdrawal of the control rods caused the water coolant to boil at a higher rate than normal, resulting in faster circulation through the core and more rapid removal of heat. Plant operation was stable at the increased power level.

Another significant factor in the improved performance is that it has been achieved with natural circulation of the coolant. Actually, EBWR is designed to take a forced circulation pump which will circulate the coolant at 10,000 gpm.

Without the forced circulation pumps, circulation has been at the rate of 7,000 gpm.

The pumps, therefore, can be omitted with a consequent reduction in capital cost.

Argonne is planning to install the pump anyway to determine what further improvements can be achieved with more rapid circulation of the coolant. Actually the pump permits better control.

Another factor that has been learned from the experiments with the reactor is that it can take more fuel elements than anticipated. This means a further increase in power.

The results with EBWR have significance for the proposed Commonwealth Edison Co boiling water reactor. Commonwealth engineers and scientists are working closely with Argonne. The new results are sure to benefit Commonwealth.

AEC Splits A-Power Division

The AEC has bowed to its critics again and has reorganized some of its functions.

In answer to charges it was mixing its regulatory and non-regulatory functions, AEC has split them up.

Effective immediately, the Division of Civilian Application has been abolished. It had handled both regulatory and non-regulatory functions. In its place has been established:

- The Division of Licensing and Regulation. This will report to the general manager and will handle all licensing and regulatory work.
- The Office of Industrial Development. This will report to the assistant general manager. It will be responsible for developing overall AEC policy for encouraging and aiding private activities in civilian application of atomic energy.

Harold L. Price, former director of civilian application, will head up the former, and his former deputy, Dr Frank Pittman, will direct OID.

Critics of AEC, led by Sen Clinton P. Anderson (D-N.M.) of the Joint Committee on Atomic Energy, have long argued that AEC's quasi-judicial functions should be separate from its other activities.

This criticism led to a JCAE staff study of AEC procedures and organization in licensing reactor facilities, published early in 1957.

At that time, Strauss told Anderson he was opposed to an amendment of the Atomic Energy Act specifically setting up a separate atomic regulatory agency. He said consideration was being given to a change of structure to meet the growing volume of regulatory work.

The News-Beat

Another Growth Year for TVA

TVA's power sales took a jump of 3.2 billion kwhr during fiscal 1957 and the area's power loads, exclusive of federal agency requirements, are rising by 750,000 to 800,000 kw a year. This was disclosed in the agency's 24th annual report, just released.

Total sales during the past year came to 57 billion kwhr, compared to 53.8 billion kwhr in fiscal 1956, it said. Of the 1957 total, 31.7 billion kwhr was sold to federal agencies (up 1.2 billion kwhr over 1956); 16.8 billion kwhr to TVA distributors (up 1.3 billion kwhr); and 8 billion kwhr to industries served directly by TVA (up .75 billion kwhr). The remaining half a billion kwhr was used by TVA itself.

The report added that rate trends "continued downward" and that "reductions are estimated to save consumers in the region $1.8 million annually."

As for earnings, "net income was $58.1 million and represented a return of 4% on the average net investment in power facilities of about $1,470 million." In fiscal 1956, rate of return was 3.9%, it added. Payments to the U. S. Treasury from power revenues came to $30 million in fiscal 1957, bringing total paid to the Treasury to over $240.1 million.

Turning to construction, the report said, "At the close of the year, construction was continuing on seven additional steam-electric units at three steam plants, all financed for the present from revenues of power operations."

'Cool' Payments

The recent FHA ruling to allow air conditioning to be included in the mortgage is seen as a spur to new home starts. This, in turn, can mean a gain in new home load for utilities. Basically, the ruling allows a buyer to carry a heavier loan in relation to his income. Quote FHA Commissioner Norman Mason, when announcing the ruling, ". . . within a few years, any house that is not air conditioned will probably be obsolescent, so FHA should start encouraging the inclusion of air conditioning."

Businessman's Directory

The jargon of business is an entity unto itself. In a world in which business plays an increasingly important part in our daily lives, we quite naturally expect its language to be a living (and sometimes laughable) one. Here are a few facetious definitions for the guidance of Organization Men:

A Program—Any assignment that can't be completed by one phone call.

To Expedite—To confound confusion with commotion.

Channels—The trail left by inter-office memos.

Co-ordinator—The guy who has a desk between two expeditors.

Consultant or Expert—Any ordinary guy more than 50 miles from home.

To Activate—To make carbons and add more names to the memo.

To Implement a Program—Hire more people and expand the office.

Under Consideration—Never heard of it.

Under Active Consideration—We're looking in the files for it.

A Meeting—A mass mulling by master minds.

A Conference—A place where conversation is substituted for the dreariness of labor and loneliness of thought.

To Negotiate—To seek a meeting of the minds without a knocking together of heads.

Re-orientation—Getting used to working again.

Reliable Source—The guy you just met.

Informed Source—The guy who told the guy you just met.

Unimpeachable Source—The guy who started the rumor originally.

A Clarification—To fill in the background with so many details that the foreground goes underground.

We are Making a Survey—We need more time to think of an answer.

Note and Initial—Let's spread the responsibility for this.

See Me, or Let's Discuss This—Come down to my office, I'm lonesome.

Let's Get Together on This—I'm assuming you're as confused as I am.

Give Us the Benefit of Your Present Thinking—We'll listen to what you have to say as long as it doesn't interfere with what we've already decided to do.

Will Advise in Due Course—If we figure it out, we'll let you know.

Give Someone the Picture—A long, confused and inaccurate statement to a newcomer.

Spearhead the Issue—You be the goat.

Four-Cornered Kilowatts

Two utilities and a construction company are considering building a big power plant in the Four Corners area of New Mexico. Reason: Huge strip coal deposits, lying just below the surface, would, in the words of Arizona Public Service Co President Walter Lucking, "support a very large generating plant for an extremely long time." But Lucking stresses that everything is still in the talking stage. The plant would produce power for a presently developing industrial area and still have enough for export to the interconnected systems of Lucking's company and Public Service Co of New Mexico. Utah Construction Co is the third interested party.

Niagara: More Compromise, Costs and Delay?

The Federal Power Commission staff has recommended changes in the proposed Niagara Falls hydroelectric project which could mean increased costs and further delay to the New York State Power Authority which is seeking a license to build the project.

The staff recommendation, if accepted by the full commission, would mean an increased cost of $17.5 million or 0.09 mill per kwhr in the cost of power from Niagara.

The recommendation will not necessarily be accepted by the commission but the chances are good that it will be, since it represents the least controversial compromise between the demands of various intervenors and what NYPA wants to do

Lewiston Opposes NYPA

The town of Lewiston and the county of Niagara have opposed the Power Authority plans for the $60 million project because of the proposal to use partly open canals to divert water from the Niagara River to a storage reservoir. The intervenors have pressed for tunnels, but the Power Authority contends this would be too expensive.

The staff recommendation backs the Power Authority on the construction of tunnels for a variety of reasons, recommending, however, that the proposed cut and cover canals be covered for their entire distance rather than left partly open as the Power Authority had planned.

Closed Canals Urged

The staff urged the fully closed canals on the grounds that this would eliminate hazards to life for adults and children; permit a more fluid civil defense program and the use of more evacuation routes in the event of danger; alleviate traffic and travel problems; eliminate the complete encirclement that would result from the open canal, other project works, the Niagara River, and railroad tracks; permit more flexible future expansion; and eliminate the possibility of sabotage by floating bombs down in the open canal.

Because of the changes recommended, the staff has also ordered that the Power Authority build a model to test the use of hinged covers. It must also make hydraulic model studies of the entire waterway to test its performance under normal load conditions and under sudden load rejection conditions.

The staff wants two independent consulting engineers to review and report on the hydraulic and structural design of the conduits.

While the staff has in effect ruled against the Power Authority in this phase of the project, it has upheld it in others. The town of Lewiston has asked that the proposed storage reservoir be decreased in size. The staff rejected this demand. And it rejected the demand of the International Paper Co for compensation for certain water rights.

NYPA, in its reply brief, sharply disrupted the recommendations of the FPC staff. Authority charged that the staff proposal for completely covered canals was never advanced during the hearing and that the staff cost estimates of the increased expenditure were incorrect.

If the staff plan is adopted, said the authority, it would require other changes such as enlargement of the Surge Bay area, and this alone would cost another $3 million.

Staff also incorrectly computed the increased power cost as a result of increased construction cost, said NYPA. Staff, it argued, computed power cost on the basis of 50-yr amortization but this is prohibited to NYPA by bond covenants.

Further, the staff failed to analyze its list of hazards and discomforts. None of these is substantial and cannot possibly justify the extra expense of $17.5 million plus $8.2 million loss of power a year, said the Power Authority brief.

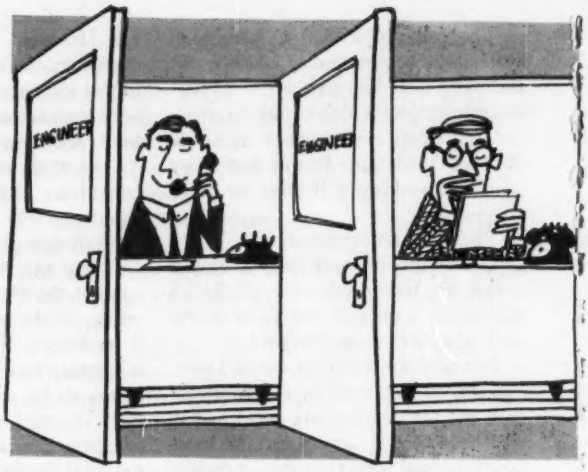
This Texas Power Class Keeps Current

Prof R. R. Krezdorn of the University of Texas has found a new way to keep his power classes up to date. Charged with putting together an advanced course on power systems for graduate students, Krezdorn chose "Electrical World" as his text, got a group subscription so that each student gets his own copy every week.

First the class studies the magazine. Then each student selects an article for further study and research, and gives a talk before the class on the contents of the article. This process keeps the students thinking and gives them practice at presenting their ideas as well.

Students like the idea of studying current developments in the industry they will soon join. Krezdorn likes it too. "But it keeps me on my toes," he says. "I can't study in advance for the lessons coming up—I have the same time for study that the students have."

1960 to 1965



Tomorrow's Engineer. Shortage: What the Utilities Are

Some engineering students were asked what they thought of a career in the electric utility industry. Here are a few of the juicier replies:

"Work is uninteresting and unchallenging."

"Salaries are too low."

"Utilities are second only to government civil service in providing do-nothing jobs."

Goaded by opinions like these, and faced with the need to recruit more engineers each year as the industry expands, utilities set out to discover where they stood and what was needed to assure them the organizations they will need in the future.

The result was the Engineering Manpower Survey, conducted by a subcommittee of Edison Electric Institute's Industrial Relations Committee. Here are some of the findings:

Engineer Shortage Will Get Worse

The supply of engineers will not keep pace with the demand for them during the next eight years. The trouble starts before college. The last 30 years have seen a marked decline in the number of high school students taking mathematics and the natural sciences.

The percentage of students taking algebra dropped from 40.2% in 1922 to 24.8% in 1955. At the same time physics dropped from 8.9% to 4.6%, and chemistry remained about the same. The only natural science to show a marked increase was biology.

Only 8% of the bachelor's degrees awarded during the academic year 1954-55 were in engineering.

EEI accepts the projection that an average of about 37,000 engineers per year will get their diplomas during 1958 through 1960. From 1960 through 1965 the average will be around 49,000 annually. In addition, each of those years should develop about 15,000 non-degree engineers.

Allowing for normal attrition, a comparison of this influx of engineers with the number of engineering jobs expected during the period shows that the U. S. will be short about 3,200 engineers per year until 1960, and around 15,900 a year from 1960 to 1965.

To see what might be done to boost enrollment at engineering schools, EEI canvassed the deans of 165 engineering colleges.

Most of the deans felt that junior and senior high school students were not being told enough about the advantages of an engineering education. But many gave equal importance to the lack of "adequate" facilities or faculty, which has forced 54% of private engineering colleges and 26% of public colleges to limit enrollment. Limitation is imminent in 17% of the remaining colleges, in the opinion of their deans.

All who offered comments urged assistance. Some deans suggested that if half the time and money spent on recruiting were directed toward equipment and faculty requirements, the engineer problem would be well on its way to solution.

Next the subcommittee took a look at recruiting. To get a picture of the most successful recruiting techniques, they selected a few companies which filled 70% or more of their needs for engineers and looked at them as a group.

Comparing the methods of the "successful" companies with the "unsuccessful" ones, a few differences appeared. All "successful" companies send recruiting pamphlets to colleges in addition to interviewing students. All advertise for college graduates.

The less successful companies send pamphlets a

The EEI survey found:

- Engineers are in short supply now, and the supply will be shorter in 1965.
- Companies most successful in hiring engineers push recruiting harder; and most pay higher-than-average salaries.
- Salaries run a bit lower in utilities, but more engineers reach high pay grades.
- Utility fringe benefits run parallel to the all-industry average.
- Utilities are employing technicians to free engineers for professional work.
- Engineering college faculties have improved their opinions of a utility career, but many are still dubious.

Doing About It Today

little over half the time, and only about ⅓ advertise.

Most other recruiting activities—undergraduate plant visits, supplying speakers for student meetings at college, and the like—are pushed a bit harder by the more successful companies.

All companies, regardless of success, hire students for summer jobs.

Scholarship aid to engineering undergraduates is supplied by less than half of the more successful companies, and by about 18% of the others.

Four out of the five utilities who have been the most successful recruiters offered higher than average starting salaries. The fifth offered the average starting salary or less.

Utility Salaries Are Not So Low

A comparison of salaries paid to engineers in the electric utility industry with those paid in general industry is not so devastating as might be supposed. Average salaries for junior engineers with under two years experience run higher in the utilities, and utility salaries are still ahead by a nose in the two to four year bracket.

After that, general industry salaries draw ahead. But a significant fact escapes the salary figures.

Although the average salary paid to electrical and mechanical engineers by utilities lags the scale for general industry in the higher grades, EEI found that a substantially higher percentage of utility engineers (33% vs 14% in other industry) actually draw pay at the highest salary levels. This would seem to indicate a greater stability of employment in the utilities which cannot be brushed aside, either as a part of career satisfaction or on a dollars and cents basis.

Another finding turned up which bucks the popular supposition that salaries in other industries lead those paid by utilities across the board. The highest actual salary paid to a senior engineer was paid by a utility. It led the high in other industry by $125 a month.

Utility salaries for engineers increased an average of 47% from 1951 to 1956 in all grades except the associate engineers (four to six years experience), who drew a 33% increase over that period.

Average starting salary for utility engineers in 1957 was $421 a month.

Fringe Benefits Run Parallel with Industry

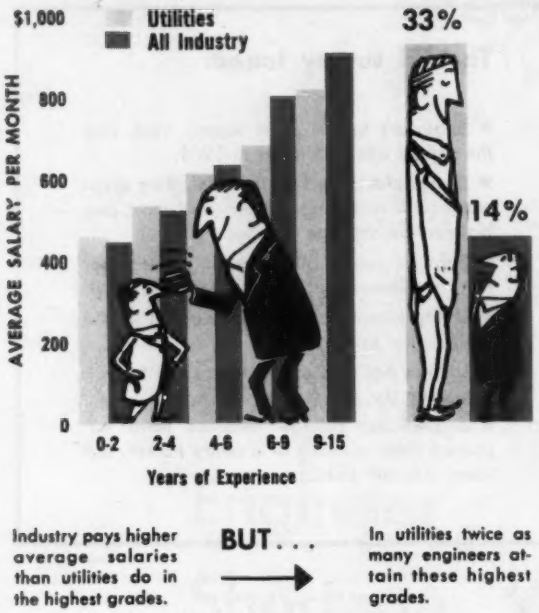
Fringe benefits in the utilities run parallel with those in other industry, the survey found. The "Big Three" (group life insurance, hospitalization, pension plan) are universal in utilities, and in other industry as well.

The typical group life plan is contributory, costing employees 60¢ a month per $1,000 of coverage, the amount of which is based on salary. After retirement the typical plan is carried at company expense, usually at a reduced amount. About 50% of the utilities require some payment by the employee after retirement, as do about 43% of other companies.

The typical hospitalization plan, too, is contributory and includes dependents. About 39% of utilities and 32% of other companies have non-contributory plans.

As to pensions, 54% of the utilities have contributory plans. In other industry only 35% are contributory. The average pension for "maximum service time" is $291 for utilities as compared with $220 for other companies, which seems reasonable since utilities have a higher percentage of contributory plans.

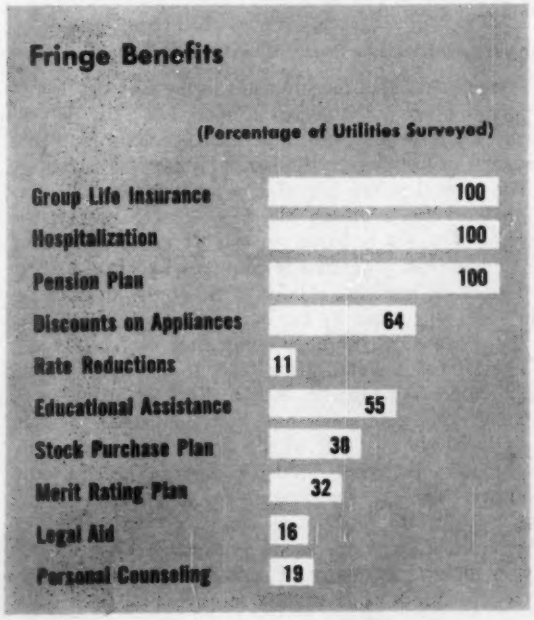
General industry is slightly more liberal with vaca-



tions; utilities are slightly more liberal with paid holidays.

Other fringe benefits mentioned include credit unions (for which the company provides space and equipment), discounts on products and services (electrical appliances in 64% of the utilities, rate reductions in 11%), educational assistance (55% of the utilities refund part of tuition cost of approved courses), stock purchase plans (38% of utilities), merit rating plans (32%), advice on personal problems (19%), and legal aid service (16%). All sponsor recreational activities.

Surprisingly, only 56% of the utilities have a plan



EEI's Manpower Survey found But the 'Power Option'

honoring long service, while 90% of the industries have such a plan.

Orientation Programs Vary

When a graduate is hired, what happens to him? The EEI subcommittee found that orientation and development programs vary widely from utility to utility. Some take as much as 33 months to complete; some are compressed into a few weeks.

Some companies put the new engineer through every department; some give him work in only a few. Some programs are coordinated exclusively through the personnel department; others, through the department in which the newly hired engineer is employed.

Characteristics of the more comprehensive plans include activities like these:

The new engineer works in each of the company's departments, training while doing productive work.

He attends group conferences to learn the history and organization of the company and its departments, and how they work.

He visits substations and other field installations.

Managers, supervisors, or a "college graduate training committee" meet with him informally, answer his questions, and help him to "work into" the company.

There is often a periodic follow-up of the engineer-in-training by means of rating scales or interviews.

Engineers Are Not Misassigned

EEI found that practically all engineers working for utilities are working at engineering—nominally at least. Evidently any poor utilization of engineers comes from dilution of the engineering content of basically engineering jobs rather than by mis-assignment.

The 9% of engineers not assigned to engineering work are managers. It is interesting to note that in the "typical" utility company, 47% of the executive officers hold engineering degrees. Thus almost half the officers come from a group which makes up only 5% of total employees.

To keep their engineering jobs undiluted, most of the companies who participated in the survey liked the practice of using non-professional and semi-professional employees to relieve the engineers of routine drafting, calculating, and estimating. They felt it not only helped meet the engineer shortage, but also made the engineers employed by the company happier in their work and more inclined to stay with it.

This system also gives the non-graduate but experienced personnel a chance to prove they can perform at a higher level.

The technician occupies an important place in the utilities today. EEI found that the average ratio of technicians to degree men was 38:100, and in one company it reached 84:100.

The company with the highest ratio of technicians uses them in the engineering, systems planning, and

utilities moving to meet the shortage is still on the wane

distribution office departments for sub-professional engineering work, giving them the title "engineering assistants." These employees have received a certificate from a two-year technical school, and many are enrolled in an evening program leading to an engineering degree.

The same company also hires high school graduates and trains them as "engineering plant assistants" in its distribution field divisions. Some take correspondence courses leading to a certificate, and a few have entered a full degree course. Similar plans are in operation to get and build engineering help in the performance department and the testing laboratory.

Another company made a study several years ago of how much non-engineering work was being done by its engineers. They discovered that engineers were spending 20% of their time on work that could be done by clerks or semi-professional employees.

In order to remedy that situation, the company now employs 203 draftsmen, estimators, and statisticians as compared with 286 engineers.

The EEI subcommittee has this recommendation:

"As a means of testing the effectiveness of a company's utilization of its graduate engineers, it may be desirable to undertake a 3-way classification of the work performed by them, as to 1) work not requiring an engineering degree; 2) administrative, operational, and supervisory work; and 3) 'pure' engineering; and to break classifications '2' and '3' into age brackets in order to ascertain future needs for engineering replacement, due to normal retirement at age 65. The results of such a study should serve to pinpoint areas in which the company might focus its attention for the most effective utilization of its engineers."

"Power Option" Is Losing Popularity

EEI made no effort to poll college engineering students about their attitudes toward electric power as a career field. Apparently the subcommitte felt that the waning status of the "power option" in engineering colleges was answer enough.

A recent poll by Southern California Edison Co of 15 far-west engineering colleges showed that of 5,000 students, only 800 were taking the power course—and that 465 of these took it as a curriculum requirement.

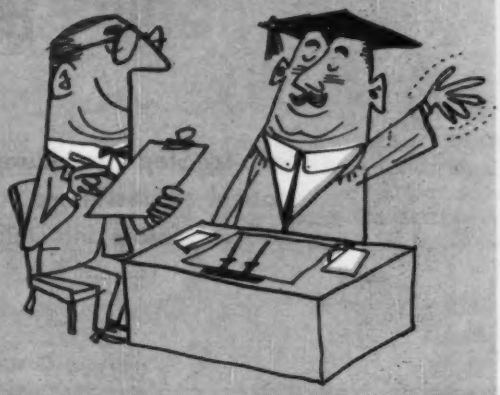
Instead of questioning the students, EEI polled the faculty—on the theory that students are greatly influenced in their choice of a career by their professors.

Faculty responses to five questions—in 1957 and in 1952, when a similar poll was taken—are shown at the right.

Attitudes expressed in 1957 are generally more favorable than they were five years before. But it appears from the EEI survey that the electric utilities actually offer more to an engineer than is supposed.

Perhaps as these facts become known—and as atomic energy adds glamor to the industry—the utilities will rise in the esteem of engineering faculties and their students.

Faculty Attitudes Have Improved Since 1952



Do you believe that the utility industry provides possibilities of progress to a position of responsibility commensurate with ability?

1952	1957
No 37%	No 22%
Neutral 3%	Neutral 16%
Yes 60%	Yes 62%

Do you believe that compensation is adequate?

1952	1957
No 69%	No 58%
Neutral 5%	Neutral 16%
Yes 26%	Yes 26%

Do you believe that utilities present a challenge to the graduate's technical competence?

1952	1957
No 42%	No 38%
Neutral 9%	Neutral 20%
Yes 49%	Yes 42%

Do you believe the utility industry has done an adequate job of presenting its advantages and opportunities?

1952	1957
No 60%	No 36%
	Neutral 8%
Neutral 5%	
Yes 35%	Yes 56%

F. J. MAGINNISS, Analytical Engineering,
General Electric Co, Schenectady, N. Y.

Here Are the ABC's of

Step-by-Step procedure is outlined for the evaluation of the mathematical expression, e^x through the use of the hypothetical digital unit, SADSAC (Slow and Deliberate Semi-Automatic Computer)

Table I The SADSAC
(Slow And Deliberate Semi-Automatic Computer)

Its Rules . . .

1 All data and all instructions are stored in pigeonholes in the machine and are given numbered addresses or locations so we can find them when needed.

2 When a number is read into a storage location, the number previously stored there is erased. When a number is read out of a storage location its value also remains in the storage location.

3 The result of any arithmetic operation ends up in a register called the accumulator.

4 A machine instruction consists of an operation part which tells it what to do, a data address which tells it where to find the operand, and an instruction address which tells it where to find the next instruction.

And Its Vocabulary of Instructions

Oper. Code	Data Address	Instr. Address	Explanation
RAdd	α	β	Reset accumulator to zero; add number at location α into accumulator; go to location β for next instruction.
Add	α	β	Add number at location α to present contents of accumulator; go to location β for next instruction.
Sub	α	β	Subtract number at location α from present contents of accumulator; go to location β for next instruction.
Mpy	α	β	Multipy the present contents of the accumulator by the number at location α; go to location β for next instruction.
Div	α	β	Divide the present contents of the accumulator by the number at location α; go to location β for next instruction.
Str	α	β	Store the contents of the accumulator in location α; go to location β for next instruction.
BrN	α	β	If the contents of the accumulator are negative, find the next instruction at location α, otherwise go to location β for next instruction.
Pch	α	β	Punch the contents of location α into a punched card; go to location β for next instruction.
Stop			Stop.

Digital computers are mysterious devices until we spend 20 minutes examining a few fundamental facts about them. Then the mystery dissipates, and the computer appears as understandable as any tool.

This article considers four basic facts about the application of a digital computer to the solution of a mathematical problem and explains how engineers go through a sequence of steps to arrive at the solution desired. The four basic facts are:

1. The machine and its means of communication.

2. The problem and the numerical techniques for its solution.

3. The flow diagram, i.e., the logical description of the problem.

4. The program itself, or the problem in machine language.

A specific problem must have a specific machine. In this article, we take a fictitious machine that comprehends a small "vocabulary" of instructions. In keeping with today's practice of using initials, our fictitious computer is called the SADSAC (Slow And Deliberate Semi-Automatic Computer). To understand its operation, we must consult the rules in Table I.

A computer operates on units of information called "words," a word being either a number or an instruction (Table I) telling the machine what to do. The machine distinguishes between numbers and instructions by the manner in which the problem is stated in machine language. This particular computer understands only the instructions in Table I.

Digital Computer Programing

If you examine Table I attentively, you will learn all that needs to be known about the operation of and communication with SADSAC.

We turn now to the problem. First we examine the numerical methods required for its solution. It is impossible to understand how a computer does a job unless we look at a few equations and follow a sequence of arithmetic operations to see what happens at each step.

Let us calculate e^x for some specific value of x where e is the base of the system of natural logarithms. Assume that $x = 1$, so that we will be calculating the value of e which we know to be approximately 2.718. The well known convergent infinite series for the computation of e^x *is*:

$$e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \cdots \quad (1)$$

If we look at two successive terms in this series, say the nth term and the $n+1^{st}$ term, we can find a general relationship for finding any term in the series from the preceding term. For example, if we multiply the n^{th} term by $\frac{x}{+1}$ we obtain the $n+1^{st}$ term as in Equation 2.

$$\frac{x^{n+1}}{(n+1)!} = \frac{x}{n+1}\,\frac{(x)^n}{n!} \quad (2)$$

As $x = 1$, the series indicated by Equation (1) becomes Equation (3):

$$e = 1 + \frac{1}{1!} + \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!} \cdots \quad (3)$$

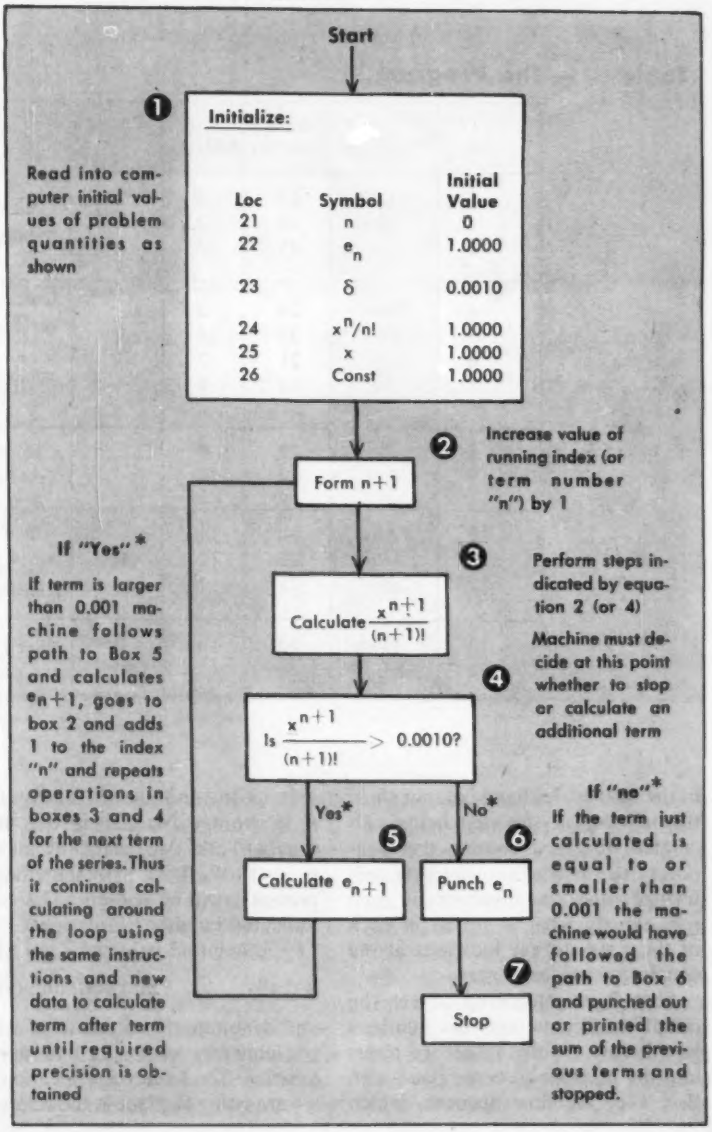
and the recursion formula for the $n + 1^{th}$ term of the series will be given in terms of the n^{th} term as shown in Equation (4):

$$\frac{1}{(n+1)!} = \frac{1}{n+1}\left(\frac{1}{n!}\right). \quad (4)$$

We have now reduced our problem to simple arithmetic. We need only to multiply to obtain the factorial quantities, divide to calculate $\left(\frac{1}{n!}\right)$ etc and add to sum up terms in our series. Equations (3) and (4) state all the arithmetic.

Note, however, that this is an infinite series; we don't want to calculate an infinity of terms. Here is where the logical description of the problem enters. We must decide on how many terms we want to calculate. If we want to add terms to the series until the next term would not

Table II — The Flow Diagram


Start
1
Initialize:
Loc
Symbol
Initial Value
21
n
0
22
e_n
1.0000
23
δ
0.0010
24
$x^n/n!$
1.0000
25
x
1.0000
26
Const
1.0000
Read into computer initial values of problem quantities as shown
2
Increase value of running index (or term number "n") by 1
Form n+1
3
Perform steps indicated by equation 2 (or 4)
Calculate $\frac{x^{n+1}}{(n+1)!}$
4
Machine must decide at this point whether to stop or calculate an additional term
Is $\frac{x^{n+1}}{(n+1)!} > 0.0010$?
Yes*
No*
5
Calculate e_{n+1}
6
Punch e_n
7
Stop
If "Yes"*
If term is larger than 0.001 machine follows path to Box 5 and calculates e_{n+1}, goes to box 2 and adds 1 to the index "n" and repeats operations in boxes 3 and 4 for the next term of the series. Thus it continues calculating around the loop using the same instructions and new data to calculate term after term until required precision is obtained
If "no"*
If the term just calculated is equal to or smaller than 0.001 the machine would have followed the path to Box 6 and punched out or printed the sum of the previous terms and stopped.

change the sum by more than 0.001, the machine must "examine" each term after it has calculated it and "decide" whether to add that term to the current sum and calculate an additional one, or halt the calculation and tell us that the job is done.

In outlining the logical steps in our calculation, we draw up a diagram showing the flow of information through the machine and any logical decision the machine must make based on information computed. Such a flow diagram is Table II. We refer to it as we detail numerical calculations of e^1. It demonstrated that the computer can make a decision on which of two courses to follow by examining data calculated and that it can perform a loop operation, going around and around the same set of instructions as often as necessary to fulfill the problem's requirements.

The problem itself consists of instructions in the "language" the computer understands, each instruction stored at a specific addressable location in the computer's memory. Table III shows the complete program for our problem. The lefthand column marked "Loc" gives the storage location where each individual instruction has been placed. There are three columns, showing the three parts of each instruction—the operation code, the data addresses, and the instruction addresses. These correspond to the operation codes and the α's and β's in Table I. In the remarks column are numbers in parentheses. These refer to the corresponding boxes in the flow diagram, several machine instructions being required to fulfill operations indicated by a single box.

In addition to the 14 storage locations indicated by the instructions, there are six more, 21 through 26, occupied by data and intermediate results. Some numbers here are constants; others vary as we progress through the steps and loops of computation.

In Table IV, each column represents the present contents of the accumulator and the data currently held in storage locations 21 through 26 as indicated by the quantities at the top of each column. Numbers

Table III — The Program

Loc	Operation	Data Address	Instr. Address	Remarks
1	RAdd	21	2	(2) Calculate and store the next value of n, the iteration number.
2	Add	26	3	
3	Str	21	4	
4	RAdd	24	5	(3) Calculate and store the next term of the series: $\frac{x^{n+1}}{(n+1)!}=\frac{n}{n+1}\left(\frac{x}{n!}\right)^n$
5	Mpy	25	6	
6	Div	21	7	
7	Str	24	8	
8	Sub	23	9	(4) Compare next term with $\delta(=0.0010)$ Test for required precision.
9	BrN	13	10	
10	RAdd	24	11	(5) Calculate and store new improved value of $e(=e_{n+1})$. Close loop and start another iteration.
11	Add	22	12	
12	Str	22	1	
13	Pch	22	14	(6) Punch answer and stop the calculation.
14	Stop			(7)

in the farthest lefthand column show the number of the step being calculated, the next column the location of the instruction currently performed, and the numbers in each row exactly what is stored in each of these six storage locations at the conclusion of each step.

Step 0 is considered to set the initial conditions, and the numbers in this row are the values we insert into the machine to correspond with Box 1 of the flow diagram, which tells us to "Initialize." The symbol n in storage No. 21 is the index number and we start by setting $n = 0$. We have said that the exponent x will be chosen to be 1. As indicated by either Equation (1) or (3), our initial value of e is 1. This is really $\frac{1^0}{0!}$, and both numerator and denominator of this term are 1; consequently we insert 1 in storage location 22. In storage location 23 we are going to place δ, the tolerance limit we have decided to use in our calculation. We have said that this will be 0.001. The next storage element, location 24, contains the quantity $x^n/n!$, and for $n = 0$ and $x = 1$, this also will be 1. Storage locations 25 and 26 contain the chosen value of x and a constant, both being 1.

Referring to program step 1, the first instruction is to reset the accumulator to 0 and add into it the contents of storage location 21. This

TABLE IV — Machine Contents at Stages of Program

Program Step	Instr. Location	Contents of Accumulator	Contents of Storage 21 n	22 e_n	23 δ	24 n x/n!	25 x	26 Const.
0		—	0	1.0000	0.0010	1.0000	1.0000	1.0000
1	1	0						
2	2	1.0000						
3	3		1.0000					
4	4	1.0000						
5	5	1.0000						
6	6	1.0000						
7	7					1.0000		
8	8	0.9990						
9	9							
10	10	1.0000						
11	11	2.0000						
12	12			2.0000				
13	1	1.0000						
14	2	2.0000						
15	3		2.0000					
16	4	1.0000						
17	5	1.0000						
18	6	0.5000						
19	7					0.5000		
20	8	0.4990						
21	9							
22	10	0.5000						
23	11	2.5000						
24	12							
Contents In Storage After Step 72		2.7181	6.0000	2.7181	0.0010	0.0014	1.0000	1.0000
73	1	6.0000						
74	2	7.0000						
75	3	7.0000	7.0000					
76	4	0.0014						
77	5	0.0014						
78	6	0.0002						
79	7					0.0002		
80	8	—0.0008						
81	9							
82	13	2.7181						
83	14	—						

puts the quantity n (which is 0) in the accumulator, all other storage locations remaining unchanged. Step No. 2 tells us to add the contents of storage location 26 to the contents of the accumulator. This adds 1 to the previous contents of the accumulator; all other storage units remaining unchanged. At Step 3 we are told to store the contents of the accumulator in location 21, which puts the quantity 1 in the n storage position. We have now gone through the arithmetic necessary for carrying out the function described in Box 2 of the flow diagram; specifically, we have calculated and stored the next succeeding value of n, the iteration number. We started with $n = 0$. We are now ready to perform the calculation for $n = 1$.

The next four instructions deal with what to do at Box 3 of the flow diagram. They may be traced out numerically by following the corresponding lines of Table IV, using the actual data stored in the various locations. At each step a change is made in the accumulator or the storage location affected by carrying out the particular instruction. Two complete loops are carried out in Table IV, and the reader, extending this table, finds that it takes seven trips around the loop to satisfy the tolerance criteria and arrive at the correct value of e, namely 2.718. The very last loop also is shown in Table IV. **End**

Here's How IP&L Designed Better

TRANSMISSION—Design

New design brings better tower performance during storms, reduces shield-wire failures, and eliminates objectionable crossarm bowing. Through elimination of vee-braces alone, cost of IP&L's new 161-kv line was reduced by $25,500

EARL E. CAMPBELL, Supervising Engineer, Transmission Lines, Iowa Power & Light Co, Des Moines, Iowa

New H-frame designs have been created for Iowa Power & Light's 161-kv Council Bluffs-Avoca-Des Moines line.

Objectives: To eliminate crossarm bowing; to reduce structure failures during storms traced to uplift forces; and to reduce shield-wire failures, galloping conductors, and failures because of heavy ice loads. A further objective was to cut costs.

The resulting designs, through elimination of center vee-braces alone, yielded a saving of $28 per structure, or a total of $25,500 for the full line.

Better Performance Promised

Through relatively simple modifications of existing H-frame designs, towers were created that promise better performance during storms. Physically they are more rugged. Electrically, they now provide two paths to ground for lightning strokes.

Here's how IP&L, with cooperation of a manufacturer, created designs to achieve those benefits:

At the outset, planners knew the line was to be a 161-kv H-frame line. Conductors were to be 556,500 ACSR, 26/7 strand. That size was determined through economic studies and requirements for future loads. Another factor was the minimum conductor diameter required to limit corona and RI voltages to acceptable levels.

The conductors are larger than those generally used on the IP&L system; the former transmission H-frames would have lacked sufficient strength to meet requirements for tangent structures. The old design would have required vee-braces to carry the heavier conductors which were selected for the line.

New designs for tangent structures, Fig 1, use a steel angle iron crosstie between pole tops. This 3x3x¼-in. crosstie adds a truss effect to the structure top and gives it adequate strength for spans up to 750 ft. This includes about 85% of the structures on the line.

For longer spans up to 1,200 ft, the crosstie is a 3x4x¼-in. angle. To improve structure strength and provide support for the center of the crossarms, center vee-braces were added.

Crossties on both structures support the shield wires and tie them together electrically. The crosstie costs little more than shield-wire support bands used with former designs. This electrical tie provides two parallel paths to ground for lightning. Shield wires were not tied together in the previous structure designs.

To minimize vibration, shield-wire attachments to the angle iron were made as shown in Fig 2. This method eliminates pole-top bands—a distinct advantage because it was sometimes necessary to shave pole tops to make bands fit.

Operating experience with H-frame lines was studied to determine what caused structure failures. During a tornado, all structures along two miles of line failed because one pole pulled out, leading to failure of the other pole.

In another storm, a mile line was lost. The storm was not of tornado proportions, but here again all structures failed similarly. Occasionally individual structures failed in the same manner.

To eliminate pole pull-out, steps were taken to anchor all poles on the new line against uplift. It was found that crushed rock aggregate used as backfill was the most effective and economic method of preventing pull-out.

Full-scale tests showed that crushed rock provided enough holding power so that other parts of the structure failed while the "uplift pole" held relatively firmly.

Aggregate for backfill stone consists of 100% by weight to pass ¾-in. screen; 40-75% to pass No. 4 screen; 20-35% to pass No. 8 screen; 22% to pass No. 16 screen; 10% to pass No. 200 screen.

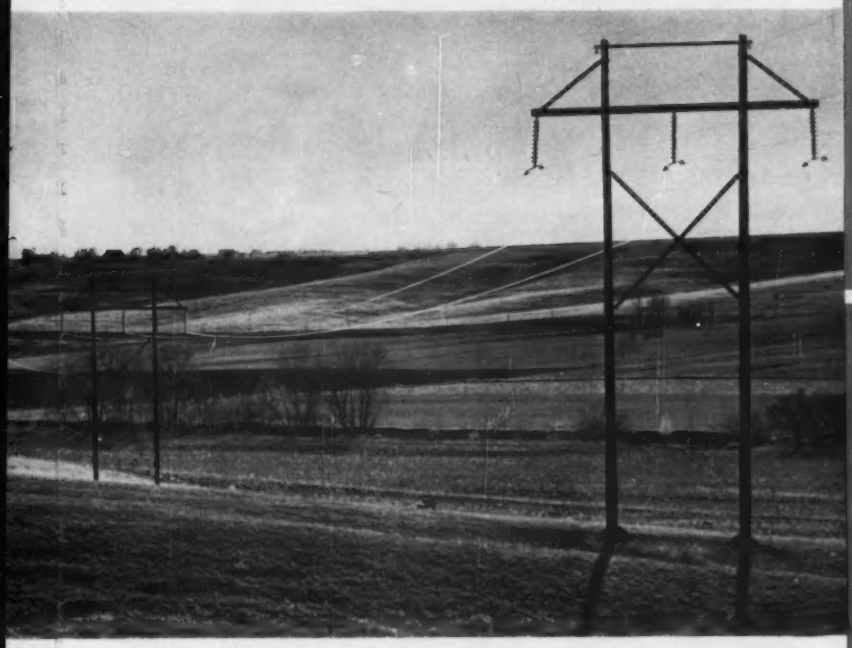
Moisture Increases Force

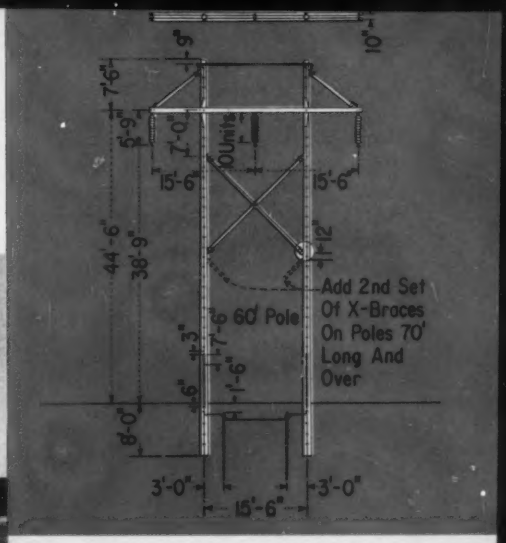
Investigations showed that crushed stone provides better holding power if it contains moisture at the time of backfilling. This, plus available data regarding the holding power of poles in uplift, enabled IP&L to use a design force of 99 lb per sq ft of surface area below ground.

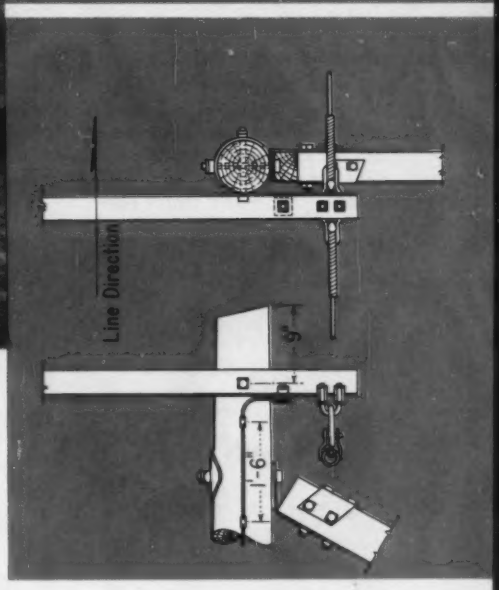
Analysis was made of the critical strength of poles in uplift, the critical strength of poles in resisting bending moments above the ground line, and the critical strength of X-braces. A composite design chart was developed, from which critical strengths of structure components are determined for various values of transverse loading due to different span lengths.

Swing angles of insulator strings presented another problem, because the line crosses rolling farm land. The problem is that of maintaining a proper relation between vertical

Transmission Towers







NEW TOWER DESIGN improves former structure. The major change was the substitution of an angle iron for vee-braces at top. Fig 1 (top right) shows scheme of tower. Fig 2 (bottom right) shows shield-wire connection to angle-iron to minimize vibration and eliminate pole-top bands

and horizontal forces acting on insulator strings. It could have been solved by deadending conductors as required by changes in ground level, or by increasing pole heights. But either solution would have been expensive.

Instead, hold-down weights were suspended from the bottom of the insulator string below the conductors. Two sizes of aluminum-painted, cast-iron, 11-in.-dia weights were used: A 25-lb weight 1 in. thick, and a 50-lb weight 2 in. thick. Number and size of weights were varied to meet local conditions.

This additional weight should prevent excessive wear and radio interference caused by lightly loaded insulator strings and suspension clamps. It should reduce insulator swing angles, provide better lightning outage characteristics, and reduce conductor galloping also.

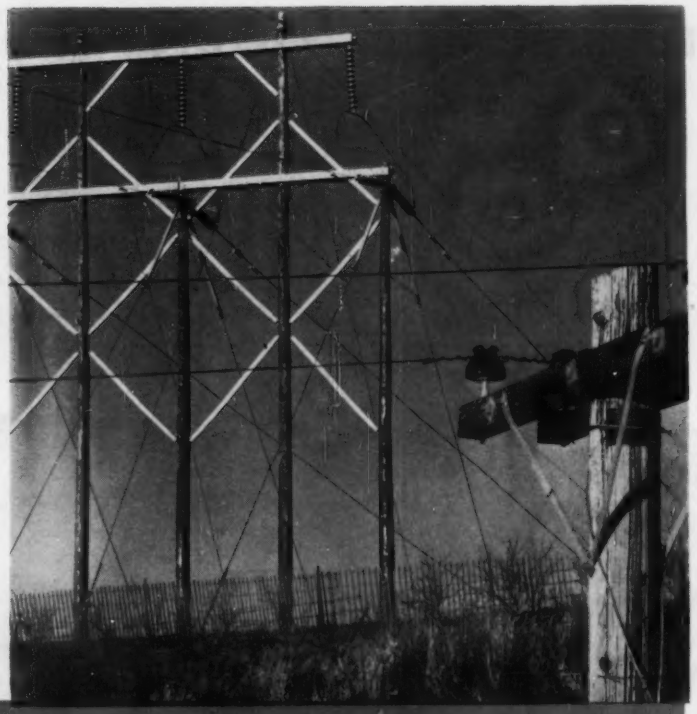
Five-Pole Deadend Used

On previous 161-kv construction, a four-pole structure was used for long-span deadends; the new line uses a five-pole deadend. The top crossarm is 3 ft from the top of the highest two poles; the lower crossarm is 12½ ft below the top crossarm, and is 41 ft above ground. Poles are spaced 10 ft apart, the short poles being buried 8 ft deep and the tall poles, 8½ ft. Extra vee-braces are applied when short poles are over 70 ft tall. Twelve insulators are used per deadend string, and the outside insulators are 6½ ft from the adjacent pole. Crossarms are 3¾ x 8¾ x 20⅓-ft double arms. Reinforcing blocks are used between double arms. Details of this structure are shown in Fig 3.

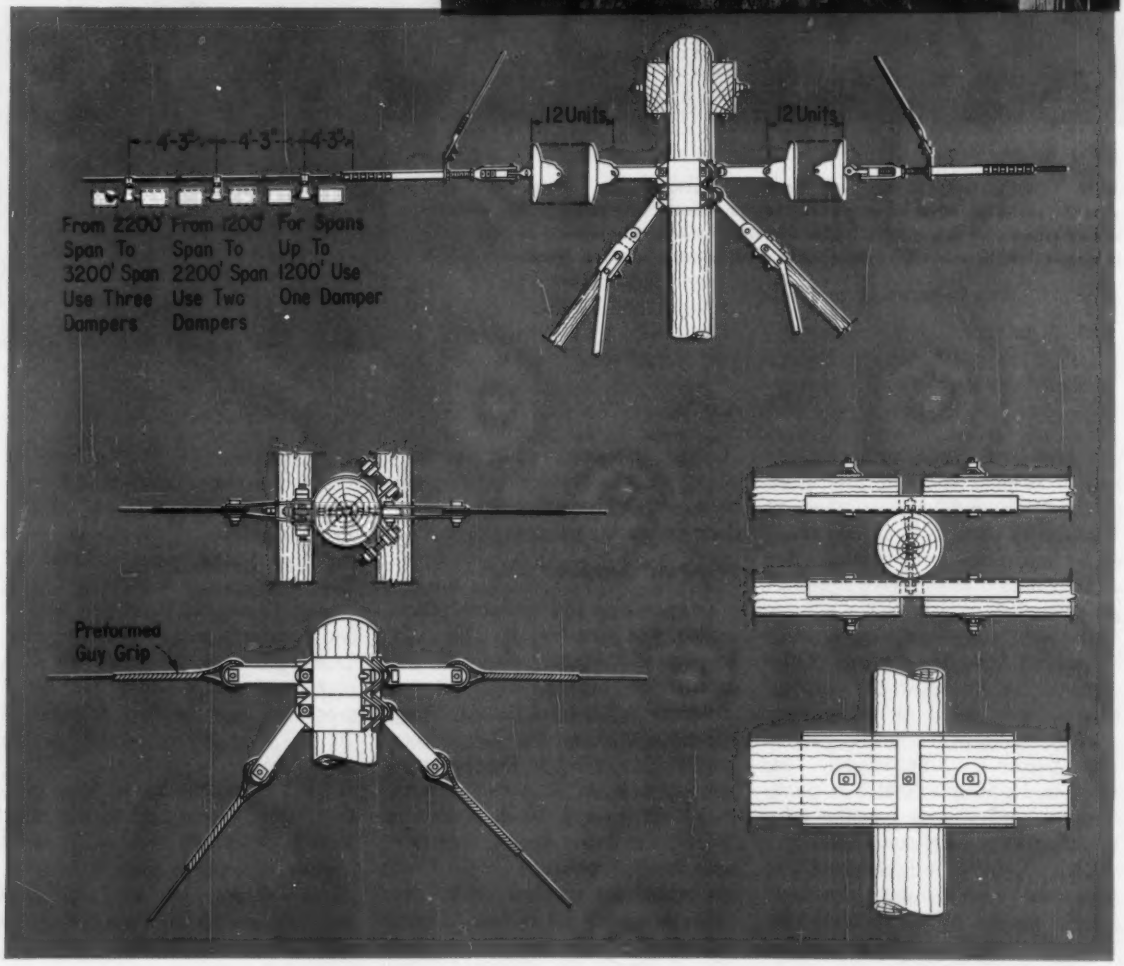
The adjustable deadends simplified construction and reduced cost. Shield wires were deadended with preformed armor rods. The lower crossarms are in two lengths of 20 ft, 4 in. each, joined at the center pole.

This structure is easier to erect—the only objection being that heavier poles are required in some applications due to column loading. In some cases, pole bands and guys may be needed between the crossarm and ground level.

Use of spacer fittings resulted in savings in design and construction. With a 10-in. arm spacing, either one, two, or no spacer fittings were used. The arrangement permits considerable variation in pole diameters without deep gains to accommodate crossarms. Preformed armor rods were used for splicing shield wires and on the conductors with dampers. Preformed guy grips also were used.



DEADEND STRUCTURE pictured at right has five poles instead of the former structure's four. Fig 3 (below) shows some details: Top drawing shows how lines are deadended; left drawing shows shield-wire deadends; right drawing shows how crossarms were joined at structure's center pole


4-3"
4-3"
4-3"
12 Units
12 Units
From 2200' Span To 3200' Span Use Three Dampers
From 1200' Span To 2200' Span Use Two Dampers
For Spans Up To 1200' Use One Damper
Preformed Guy Grip

Quaker Oats Revamping Strives for Safety and Economy

Special starter design and dual element, high-capacity fuses cut hazards in serving inherently dusty process

WALTER H. PROESCHOLDT, Asst. Chief Engineer, Quaker Oats Co, Chicago, Ill.

Heavy reliance on simple 3-phase induction motors and an extra margin of interrupting capacity for switching devices characterized the rehabilitation of the electrical distribution system at Cedar Rapids mill of Quaker Oats Co. Serving an area where grain and cereal dusts are a potential explosion hazard, the system was designed to be inherently safe and independent as possible of the growth of the nearby utility power plant.

All motors are started across the line, the electrical system being "stiff" enough to start them without troublesome voltage drop. Dust-tight starters, with specially designed rubber gaskets, were used wherever a mechanical accident might release dust into the air.

The new distribution replaced a two-phase system designed in 1916. The mill was then served at 2.3-kv from five 800-MCM, 4-wire, underground cables, terminated inside the mill in a solid bus. Scott-connected autotransformers converted to 3-phase. Some 440-v, 3-phase power was used also.

When this system was designed, the installed electrical capacity of the adjacent utility power station was 16,000 kw, and interrupting duty on the mill bus was 50,000 kva. By 1955, station capacity was over 90,000 kw, with an additional 30,000 available from outside sources. Mill bus interrupting duty was approximately 800,000 kw.

To maximize supply reliability of the new system, two 13.8-kv feeders, one overhead and one underground, supply power from the nearby Iowa Electric Light & Power Co power plant. Situated about 1,500 ft away, the IEL&P plant supplies the Quaker Oats mill with electric power, steam, and stack gas. In turn, the mill supplies the power plant with returned condensate and furfural residue for use as a fuel.

Incoming Power is 13.8 Kv

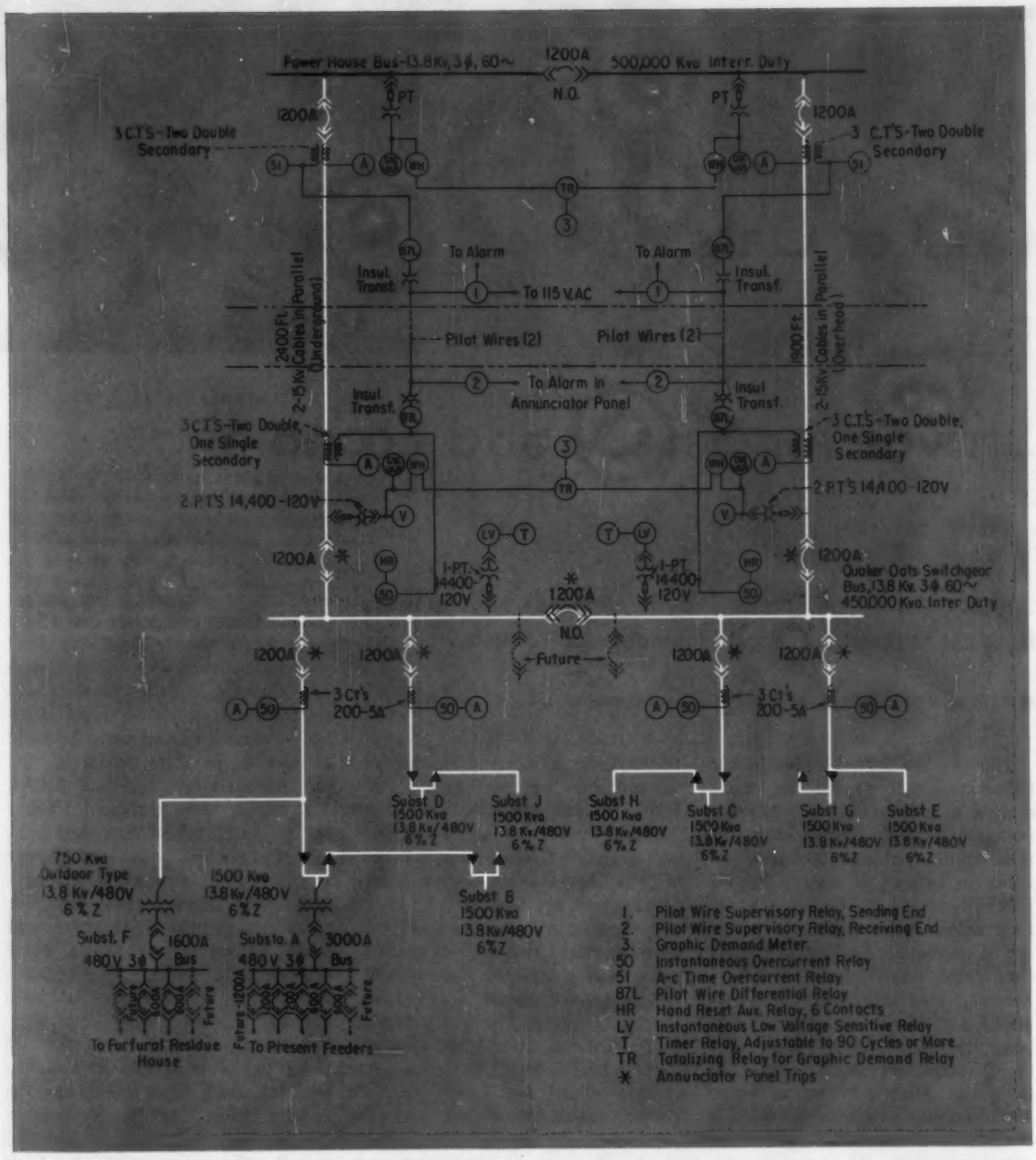
The overhead feeder is on the bridge that carries the fuel pipes between the mill and the power plant. The combination of overhead and underground feeders was used because it was felt that the underground circuit would not be subjected to the same hazards as the overhead, and vice versa.

As generation in the power plant is at 13.8-kv, power is tapped directly from the industrial ring bus and fed to the mill. The underground feeder comprises two 15-kv 3-conductor paper insulated lead covered, compact sector cables, with jute covering outside the lead and an 0.004-in. shielding tape. 500-MCM copper was required because of duct temperature problems. On the overhead run, two 250 MCM, 3/c cables were sufficient. These cables use 21/64-in. varnished cambric, interlocked paper and copper tape shielding, interlocked non-magnetic binder tape with polyvinylchloride tape, interlocking armor, and a pvc jacket overall. Cost, cable quality, and pulling requirements determined the selection of both cables.

Either feeder can carry the full plant load, about 12,000 kva. In practice, both lines are always in service, with the tie air circuit breaker open. Relaying is installed to trip out any line on which a fault may occur and simultaneously close the tie breaker.

For a primary distribution, 13.8 kv was selected because such equipment was considered to be safe, adequate, and reasonably inexpensive. The 13.8-kv feeders serve nine 13.8/480-v unit substations, one a 750-kva outdoor type, serving the furfural residue house. The other units are rated 1,500 kva. All have a 6% impedance and include provisions for expansion.

Wherever practicable, substations were placed at load centers. How-


Power House Bus-13.8 Kv, 3 ϕ, 60~
1200A
500,000 Kva Interr. Duty
N.O.
PT
1200A
3 CTS-Two Double Secondary
3 C.T'S-Two Double Secondary
To Alarm
To Alarm
Insul. Transf.
Insul. Transf.
To 115 V.AC
Pilot Wires (2)
Pilot Wires (2)
2400 Ft. 2-15 Kv Cables in Parallel (Underground)
300 Ft. 2-15 Kv Cables in Parallel (Overhead)
To Alarm In Annunciator Panel
3 C.T.S-Two Double, One Single Secondary
3 C.T.S-Two Double, One Single Secondary
2 P.T'S 14,400-120V
2 P.T'S 14,400-120V
1-PT. 14400 120V
1-PT. 14400 120V
1200A
Quaker Oats Switchgear Bus, 13.8 Kv. 3 ϕ 60~ 450,000 Kva. Inter Duty
Future
3 Ct's 200-5A
3 Ct's 200-5A
Subst D 1500 Kva 13.8 Kv/480V 6% Z
Subst J 1500 Kva 13.8 Kv/480V 6% Z
Subst H 1500 Kva 13.8 Kv/480V 6% Z
Subst C 1500 Kva 13.8 Kv/480V 6% Z
Subst G 1500 Kva 13.8 Kv/480V 6% Z
Subst E 1500 Kva 13.8 Kv/480V 6% Z
Subst B 1500 Kva 13.8 Kv/480V 6% Z
750 Kva Outdoor Type 13.8 Kv/480V 6% Z
1500 Kva 13.8 Kv/480V 6% Z
Subst. F 1600A 480V 3ϕ Bus
Subst. A 3000A 480V 3ϕ Bus
To Furfural Residue House
To Present Feeders
1. Pilot Wire Supervisory Relay, Sending End
2. Pilot Wire Supervisory Relay, Receiving End
3. Graphic Demand Meter
50 Instantaneous Overcurrent Relay
51 A-c Time Overcurrent Relay
87L Pilot Wire Differential Relay
HR Hand Reset Aux. Relay, 6 Contacts
LV Instantaneous Low Voltage Sensitive Relay
T Timer Relay, Adjustable to 90 Cycles or More
TR Totalizing Relay for Graphic Demand Relay
* Annunciator Panel Trips

TWIN FEEDERS at 13.8 kv, one overhead and the other underground give reliable service to the Quaker Oats mill. Air circuit breakers, along with non-inflammable transformer oils, reduces fire hazard in processing area atmosphere

ever, because this was essentially a rehabilitation rather than a completely new design, some unit substations had to be installed at the point of feeder concentration where it was most convenient to pick up existing circuits.

All circuit breakers were air filled, as inflammable oil is undesirable in the plant. All transformers in unit substations are filled with non-inflammable oils. The mill engineers were reluctant to use air-cooled transformers unless the cooling air was specially cleaned and filtered. Dust getting into air ducts may seriously impede cooling, and there is no practical way to insure cleanliness.

From the feeder air circuit breakers in the unit substations, power is fed to the power distributing panel boards at 480 v. As its cost was lower than cable in conduit, 600-v interlocked armored cable was used for the 440-v circuits between the low-voltage switch gear and the distribution panel boxes. Rated 538 amp at 104F, it is a 500-MCM 3/c cable, with a thin pvc jacket to exclude grain bugs.

These panel boards are in quite clean areas. They consist of a main 440-v bus with fused feeder branches which have a disconnecting feature. From the panel boards, circuits are wired to each individual starter. Before going into the design, a study was made to determine the largest size motors that might conceivably be used within the mill. Based on this survey, the largest single motor for a direct drive is about 250 hp.

A 440-v, 3-phase, 60-cps utilization voltage was selected principally on the basis of economics. The data used was a combination of motor and starter costs plus distribution costs. There were no advantages in using 220 v. Starters, wiring, and conduit would cost more, and motors about the same as 440-v units. Adequate interrupting capacity was also considered in selecting the utilization voltage. It was felt that properly selected 440-v equipment was perfectly safe as well as readily available.

One big element affecting design of the distribution system was the desire to have an extremely safe plant in spite of the possibly hazardous operation. Dusts are on the verge of being an explosive mixture at all times. The furfural residue sent to IEL&P for fuel contains 36 to 38% oxygen. Although milling engineers do everything practicable to provide dust-collecting equipment and operating people do a very good job of housekeeping, there is always the possibility of a broken machine or connecting spouts spreading dust over the place.

Design Minimizes Hazards

Electrical circuits and equipment had to be of a type that would minimize any possible fire or explosion. An important safety element is proper design of distribution circuits to assure that all equipment operates within safe limits. Part of our general philosophy was that every electrical switching device in the system should have an interrupting capacity greater than the duty on it. Encasement of electrical facilities was not a major concern. It was felt that correct design would do the trick.

The system was intended to be as independent of the growth of the utility power station as possible. Within the past 30 years growth in generating capacities has been tremendous, and in years to come concentrations of power will become much greater. But use of a series of properly sized unit substations makes the industrial electrical system independent of the capacity of the source: No more short circuit current can pass through than the transformer impedance permits.

Motor loads in the mill include grinders, hullers, conveyors, elevators, digesters, sewing machines, and a variety of other applications. Ratings range from fractionals to 250 hp. Motor sizes in the milling industry are not worked out as finely as in other industries. Grains vary, and motor capacity must be sufficient to meet the requirements of the most difficult grain conditions. On motors rated more than 10 hp, the mill uses capacitors to keep power factor and voltage up.

Favor Squirrel-Cage motors

Dust-tight, Class II, Group G motors were used in all areas which might become dusty through an accident, such as a broken spout carrying milled material. Three-phase, squirrel-cage induction motors were used throughout. These motors have no sparking or arcing, and we believe that they are one of the safest electrical machines made when properly maintained.

In studies covering 30 years time, we have not found one case where a squirrel-cage induction motor caused a fire because of its design, regardless of its type of frame. Even the very old open motors have not caused us any trouble traceable to the frame design. Many of our older motors are not encased. We consider single-phase motors to be sparkers, even on fractional hp applications.

Many troubles blamed on motors should properly be placed on starters and other equipment and services. We firmly believe a dust-tight starter, periodically cleaned as a part of an established preventive maintenance program is the safest and best from all points of view. Some starters are being built by Quaker Oats to our own specifications.

To provide a dust-tight seal, a special soft rubber (not sponge) was used for gaskets. This rubber is expected to last 20 years. The inside of the starters was painted white so that dropped nuts and screws can be easily found. To make the system as flexible as possible and assure maximum equipment salvage in the event of a change, individual starters were used. These may be banked together wherever convenient.

BRIDGE brings one set of 13.8-kv feeders to mill, takes furfural residue to utility station in the background

All starters are the switched fuse combination type. The disconnecting feature assures maintenance people that there is no power on when they work on a machine.

Dual-element, high-interrupting-capacity fuses were used throughout. These interrupt 50,000 amp at 440 v and constitute one of the greatest safety elements in the design.

Starter boxes have no knockouts. Holes are drilled to the diameter and in the place wanted. A dust-tight pipe connection with a rubber gasket connects the inside of the box. Reset buttons with rubber coverings permit operators to use them without opening the starter boxes or otherwise affecting their dust-tightness. A six-month inspection program assures that the insides of the boxes are kept clean.

Approximately 90% of the motors are direct drive. There are some line shafting and belt drives left, chiefly because they were in existence and the change-over is a step-by-step process.

Had the mill been completely new construction, all equipment would be directly driven, as line shafting, with its attendant belting, wastes about 65% of the applied power in friction. Moreover, flat belt drives tend to produce static electricity which can easily trigger

(*Continucd on page* 122)

Delayed Coke

Mixed half and half with coal it's burned by new 150-Mw unit in specially designed boiler at Vepco's Yorktown. Limited experience indicates that operation is satisfactory

JOHN M. McGURN, Assistant System Superintendent-Production, Virginia Electric & Power Co, Richmond, Va.

Delayed coke mixed with coal fuels a specially designed 150-Mw unit at Virginia Electric & Power Co's Yorktown power station, where limited experience indicates that operation is satisfactory and production costs lower. Fuel cost savings more than offset the slightly poorer heat rate and charges for the special design.

Special plant features counteract the undesirable characteristics of delayed coke, these pertaining to boiler parts in direct contact with the fuel or ash. Design grew out of a 1955 contract between Vepco and American Oil Co. The contract has these effects for the two companies:

- Amoco obtains a market for its residual by-product—delayed coke and surplus refinery gas; cooling water with a minimum of facilities and initial cost; and, a dependable economical power supply.
- Vepco obtains a desirable power station site in a rapidly expanding load area scare in such sites, a large high-load-factor industrial customer, and a source of low-cost fuel equivalent to 500 tons of coal per day.

The completed Yorktown station will have two 150-Mw units, the first of which has been in commercial operation since July 25, 1957. Its fuel requirements are equivalent to about 1,000 tons of coal per day, half being supplied by the delayed coke from the refinery.

Delayed coking converts residual hydro-carbons to lighter, more highly valued distillates and to by-product petroleum coke. It differs from thermal cracking in that the reduced crude is heated rapidly and flows to isolated drums where it is coked by its own heat. The residual product, which solidifies in the drums, is delayed coke which has the appearance of run-of-mine coal. As it is a relatively friable material, subsequent handling reduces it to a product resembling slack coal except for some large lumps.

Analysis of Delayed Coke and W. Va. Bituminous Coal

Proximate Analysis % WT	Coal	Delayed Coke
Moisture	4.00	4.00
Volatile matter	31.00	11.50
Fixed carbon	57.00	83.70
Ash	8.00	0.80
Btu per lb (as fired)	13,500	14,830
Btu per lb (dry)	14,060	15,450
Sulfur	1.10	4.50
Grindability Hardgrove	55	90
Ash softening temp, F	2,650	2,200–2,700
Vanadium	.....	0.1–0.3
Sodium	.....	0.02–0.05
Benzol solubles	.....	2–3

Sulphur and Vanadium Present

Delayed coke from 100% Venezuelan crude is compared in the accompanying table with West Virginia bituminous coal. Its undesirable characteristics are a low volatile content, wide range of ash fusion temperature, high sulphur content, and presence of vanadium.

As physical and chemical properties of delayed coke seriously affect a generating unit's performance

Adapted from a paper presented at the Southeastern Electric Exchange Engineering & Operation Section meeting, Atlanta, Ga.

Cuts Generation Fuel Costs

and dependability, the contract provides for a reduction in coke price when certain characteristics deviate from specified values. Penalties are imposed when volatile matter is less than 9.0%, sulphur in excess of 5.5%, moisture content greater than 7.5% after air drying, and Hardgrove grindability less than 55. Amoco pays a proportionate share of any abnormal boiler maintenance expense attributable to vanadium and sodium.

Delayed Coke Blended with Coal

Initially, the low volatile content was of particular concern as stable ignition could not be maintained over normal load range without a supplementary fuel. This problem was solved by limiting the supply of delayed coke to only 50% of the fuel requirements of the initial unit. Coke is blended with bituminous coal in the pulverizers to provide an homogeneous fuel mixture of medium volatility.

Delayed coke is burned in a controlled circulation boiler of the radiant-heat type with a divided furnace arrangement and a rating of 1.2 million lb/hr. The pulverized fuel mixture is fired in tilting tangential burners. Several features in the design of the unit counteract the undesirable delayed-coke characteristics:

1. The furnace was designed for about 10% lower heat release than that normally employed for coal. The larger furnace volume improves combustion and reduces carbon loss by lengthening retention of the low-volatile fuel in the furnace proper. Increased furnace surface should minimize vanadium-sodium attack in the superheater and reheater by limiting the entering gas temperature to maintain metal temperature below 1,150F.

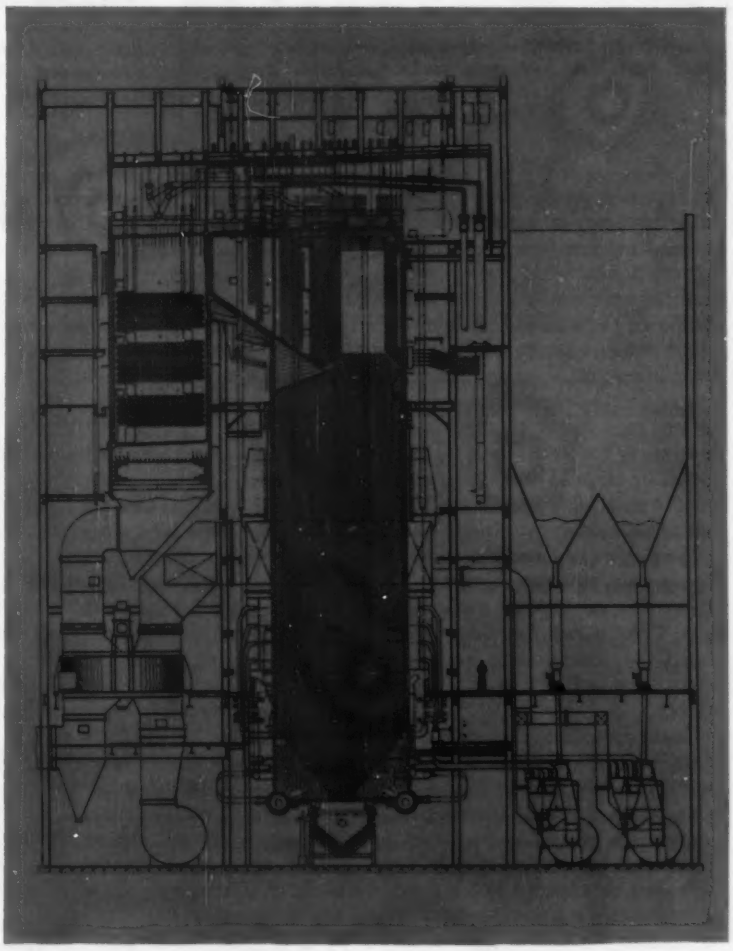
2. Vanadium-sodium attack is minimized by water-cooled spacers and hangers in the superheater and reheater sections and by avoiding alloys containing nickel and molybdenum.

3. Induced-draft fan ducts, air preheater rotor, intermediate and cold-end elements and housing, and the mechanical dust collector housing and hopper were constructed of Corten, a corrosion-resistant material minimizing sodium and vanadium attack in the induced-draft system. To protect the regenerative air preheater further, an oversize steam air heater maintains the mean cold-end metal temperatures above 245F.

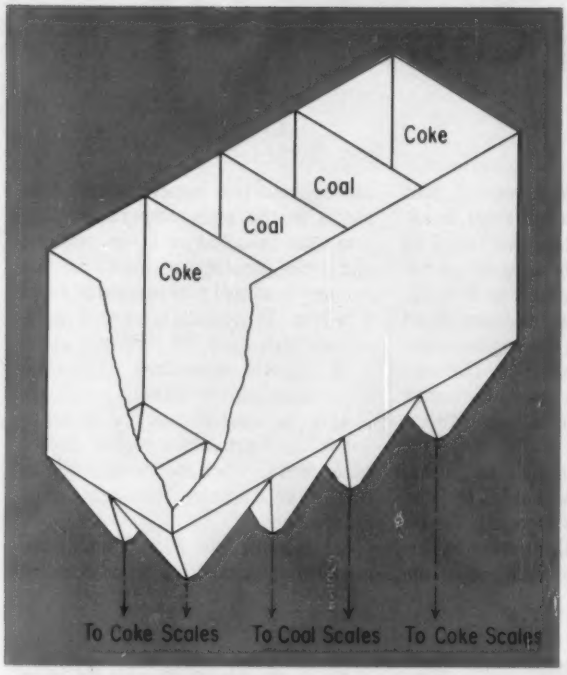
4. Excessive slagging and fouling of the superheater and reheater surfaces by the wide range ash fusion temperatures was eliminated by increased spacing of the elements throughout the superheater. Elements in the high-temperature section were installed on 16-in. centers, and open spacing of those in the primary sections was increased from 1 to 2 in. Intermediate section spacing was enlarged proportionally.

5. Slightly oversized Raymond pulverizers permit handling of coke containing a small amount of residual oil and provide a higher degree of fineness, when necessary, to insure more complete combustion of delayed coke.

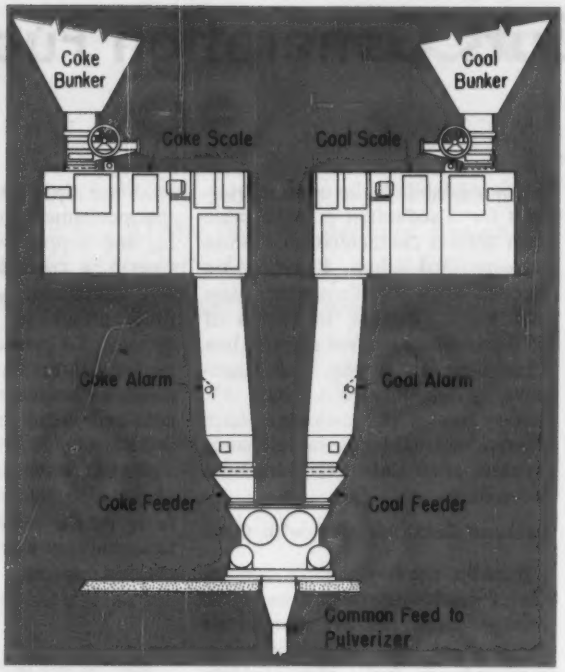
Except for the 325-ft stack, the only other deviations from conven-



BOILER is of radiant reheat type with divided furnace arrangement rated at 1.2 million lb/hr. Steam conditions are 2,000 psi, at 1,000/1,000F



PARTITIONED BUNKER provides separate storage of coal and coke. Fuels are carried to bunker on single-belt system



COKE AND COAL are fed to pulverizer through twin-feeder arrangement. Four pulverizers are installed in the plant

tional design were those for handling the fuel combination. Hydraulic decoking removes coke from the refinery drums. This consists of mechanical boring followed by impact cutting of the material in layers by a high-velocity rotary water jet. Cut coke drops to a sump below the drums and is removed by a drag scraper to a dewatering pile. After dewatering for 48 hr, coke is transported by large earth-moving equipment to air-drying piles in the Vepco fuel storage area.

Here natural drainage and air drying cuts moisture content from 10 to 4% or less in about seven days. Coke is removed then by bulldozers to the nearby reclaiming hopper for delivery to the station bunker.

Coal and coke are handled by the same coal-conveying equipment. The initial installation is a single-belt system arranged to permit separate storage of coal and coke in the partitioned bunker, so that the two fuels may be blended in the desired proportion in each pulverizer. The partitioned bunker has four sections. Coke is stored in the outer ones; coal in the others.

Four pulverizers in a rectangular pattern have identical fuel-feed arrangements. Coal and coke flow from the bunker to separate scales and through a twin feeder to a pulverizer. The combustion-control system automatically maintains a predetermined ratio of coal to coke.

High Ratio of Coal First Used

As delayed coke was initially fired in the unit on July 20, only limited operating and maintenance experience is available. Fuel was first fed to the pulverizer in a ratio of 30% coke and 70% coal. Gradually the coke was increased to 65%. Throughout this range of firing, station load being varied from 50% to maximum output, ignition was quite stable and furnace conditions appeared good.

A normal firing rate of about 50% coal to 50% coke has been maintained, the unit operating at maximum output almost continuously since the beginning of commercial operation. This schedule has restricted testing.

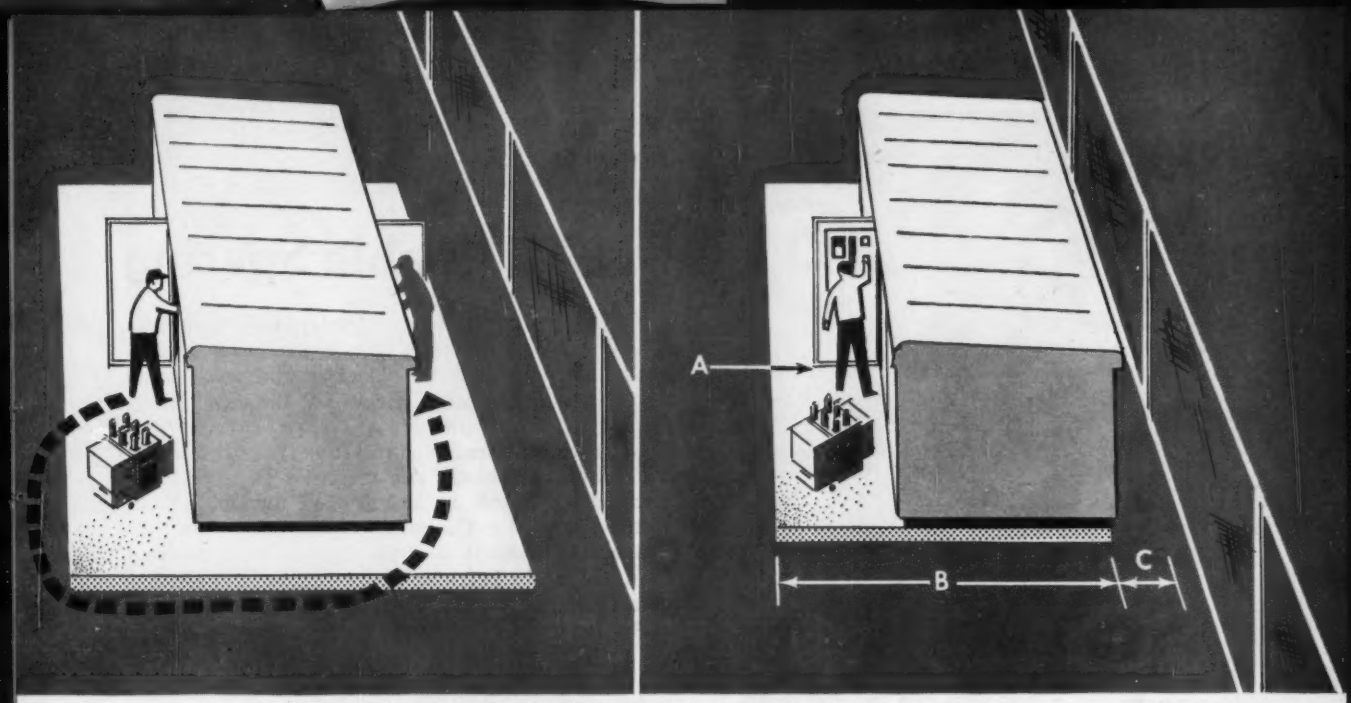
In general, the exceptions being a few minor aspects, operation has been quite satisfactory, and no great difficulties have been experienced. Some immediate effects observed in burning the coal-and-coke mixture were:

Fuel ignites in the furnace several feet farther from the burner than when firing coal. In the load range of Vepco's operation, no adverse effect on flame stability has been observed, such as could result in difficulty in maintaining ignition at extremely light loads without a supplementary fuel. Sufficient refinery gas will be available to sustain ignition.

When coke was added to the fuel mixture, superheat steam temperature rose several degrees, indicating delayed combustion. Initially, when firing coal, rated superheat and reheat temperatures could not be obtained until a fairly heavy layer of ash had been deposited on the furnace walls. But when coke was used, the quantity of ash adhering to the walls lessened considerably, and the ash deposited, being very fragile, was shed from an entire wall by a single soot blower.

Delayed combustion and the cleanliness of the furnace walls con-

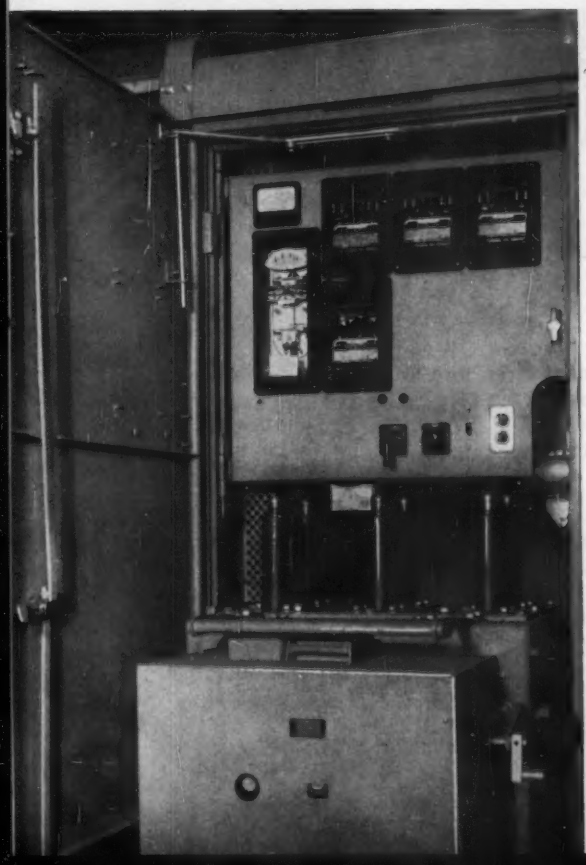
(*Continued on page* 122)



New G-E metal-clad design eliminates moving from one side of unit to other for operation or maintenance, puts breaker and control at one position (A). New design also allows you to (B) cut foundation size, and (C) save station space.

NEW General Electric outdoor metal-clad design helps . . .

Slash Installation, Maintenance Costs



To help you cut your operating budget, General Electric is building outdoor metal-clad switchgear with the control panel on the same side of the unit as the breaker.

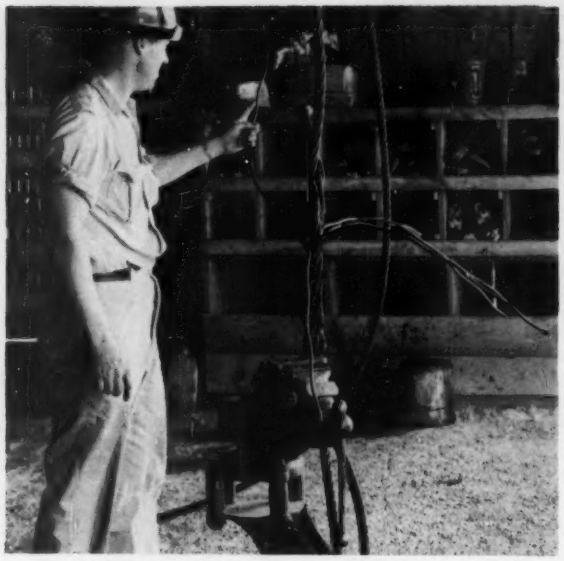
With the new gear, you need only one operating aisle, significantly reducing foundation pad size. You save excavation costs and material. Since access to the rear of the equipment is no longer necessary, you save station space.

Maintenance and testing is easier and quicker with G.E.'s new metal-clad because the breaker, relays and control are all accessible at one position. Maintenance men will not waste expensive time moving from one side of the unit to the other. The "dutch door" control panel swings out to provide easy access to bus connections. Also, the breaker can be removed without disturbing the panel.

The new outdoor metal-clad is available with a preassembled protected aisle as optional equipment. For more information, contact your nearest General Electric Apparatus Sales Office, or write Section 511-28, General Electric Company, Schenectady 5, New York.

Progress Is Our Most Important Product

GENERAL ELECTRIC



DISTRIBUTION—Maintenance

Rig Aids Cable Splicing

A steel-cable splicing rig, developed by Tennessee Valley Authority, provides greater safety, as all elements can be anchored by a "lock" during splicing and wrenches are not needed. Release of the lock permits freedom of movement.

Basic elements are a pipe vise suspended horizontally overhead and a bench vise revolving on a pedestal. The pedestal rotates on the hub of an automobile front wheel. Attached to the hub is a base plate notched for locking the pedestal after the lay has been removed from the cable being spliced. The bench vise has notched jaws and attachable chucks notched to hold cables ranging from ⅛ to ⅞ in.

SUBSTATIONS—Testing

Erratic Tests Traced to Faulty Terminals

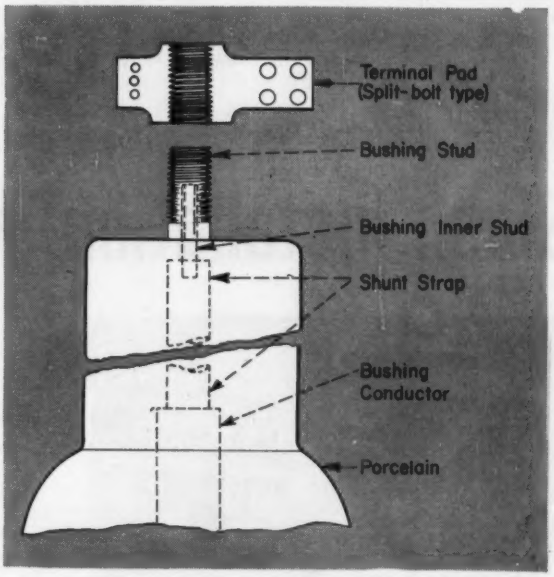
M. L. FERGUSON, System Electrical Engineer, Ohio Valley Electric Corp, Chillicothe, Ohio

Loose terminal pads on the jumpers connected to the bushings of 345-kv breakers have caused inconsistent results in Doble tests.

About 1½ days were wasted by an Ohio Valley Electric Corp test crew in draining oil from a tank to ascertain the reason for inconsistent readings. The trouble was finally traced to a loose terminal pad. During recent tests at Clifty Creek, all bushing studs on two breakers, and two studs on another breaker were found to be loose.

Apparently, loose studs result from incorrect installation of the terminal pads on the bushings. Three possible conditions are: Loose terminal pads; tight terminal pads, but loose inner stud in the bushing top; or, a combination of the foregoing.

Accordingly, extreme care must be taken in tightening studs to prevent the shunt strap from twisting enough to break, particularly when the stud takes many turns to tighten. To date, only one stud has needed more than one full turn to attain the desired tightness.



Yet, as a result of experience, Ohio Valley Electric now checks all bushing studs before Doble tests. This procedure is recommended for all 345-kv bushings.

SUBSTATIONS—Maintenance

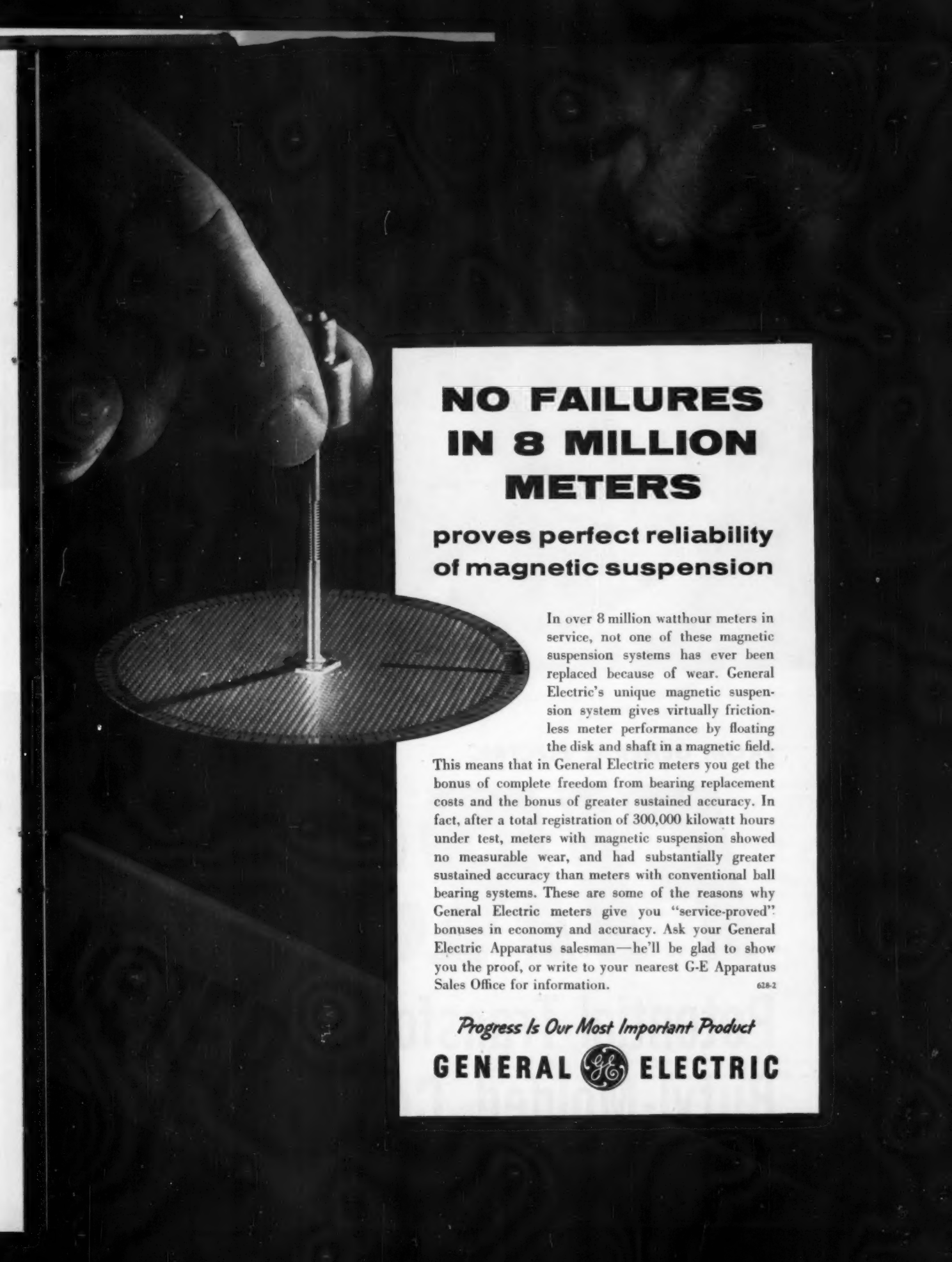
Sack Holds Fuller's Earth

To facilitate cleaning, Toledo Edison Co places fuller's earth in a sack before putting it into a filtering tank. This allows the filter operator to remove the sack with the fuller's earth when the used filtering material needs cleaning. Formerly the fuller's earth was poured into the filter tank and scooped out when it had to be cleaned.

Sometimes, in the scooping out process, the copper screen at the bottom of the tank was damaged. Repairs were expensive and time consuming.

The new method is easy and economical.

(*More How to on page* 72)



NO FAILURES IN 8 MILLION METERS

proves perfect reliability of magnetic suspension

In over 8 million watthour meters in service, not one of these magnetic suspension systems has ever been replaced because of wear. General Electric's unique magnetic suspension system gives virtually frictionless meter performance by floating the disk and shaft in a magnetic field. This means that in General Electric meters you get the bonus of complete freedom from bearing replacement costs and the bonus of greater sustained accuracy. In fact, after a total registration of 300,000 kilowatt hours under test, meters with magnetic suspension showed no measurable wear, and had substantially greater sustained accuracy than meters with conventional ball bearing systems. These are some of the reasons why General Electric meters give you "service-proved" bonuses in economy and accuracy. Ask your General Electric Apparatus salesman—he'll be glad to show you the proof, or write to your nearest G-E Apparatus Sales Office for information. 628-2

Progress Is Our Most Important Product

GENERAL ELECTRIC

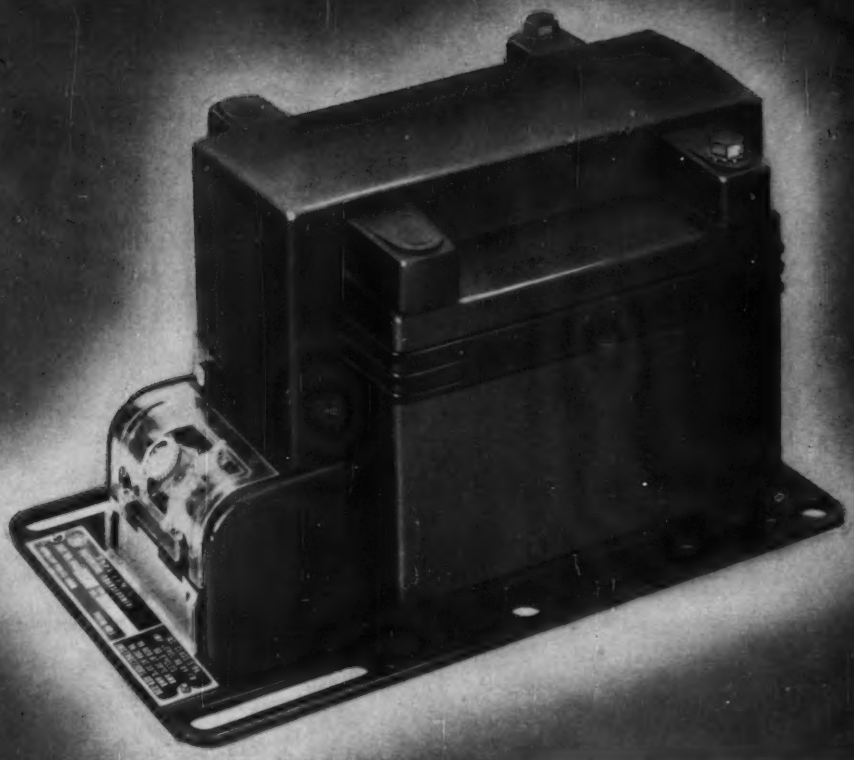
JVW-3 Outdoor

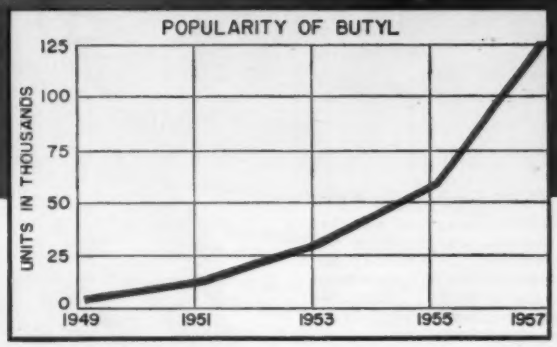
INSULATION CLASS:	5 KV
IMPULSE LEVEL:	Full Wave, 60 KV
ACCURACY CLASS:	0.3 W, X, Y, 1.2 Z
FREQUENCY:	60 cycle
THERMAL RATING:	600 va, 30 C ambient
HEIGHT AND WEIGHT:	12 13/16 in., 50 lbs

FROM GENERAL ELECTRIC

FIRST

Potential Transformers With Butyl-Molded Construction





JVM-3 Indoor

INSULATION CLASS:	5 KV
ACCURACY CLASS:	0.3 W, X, Y, 1.2 Z
IMPULSE LEVEL:	Full Wave, 60 KV
FREQUENCY:	60 cycle
THERMAL RATING:	600 va, 30 C ambient
	200 va, 55 C ambient
HEIGHT AND WEIGHT:	7¾ in., 32 lbs

NOW . . . to reduce your metering and relaying costs . . . General Electric offers the first butyl-molded potential transformers. Designed for circuits up to 5-KV, indoor and outdoor, the new butyl-molded potential transformers provide greater service reliability, easier installation, at less maintenance and replacement expense.

HIGHLY ACCURATE, the new butyl-molded pots meet or exceed ASA standards for accuracy and combine all the advantages of molded butyl—already well known to users of General Electric's wide line of molded current transformers.

SMALLER AND LIGHTER, with size reductions up to 50 per cent, the new butyl-molded potential transformers make possible significant space savings in substations and switchgear . . . can be mounted in any position, resulting in less costly wiring.

TOUGH, FLEXIBLE BUTYL serves as combined bushing, case, and insulation. Both indoor and outdoor types are fire and explosion-resistant and have a low, stable power factor. Creepage and flashover distances are equivalent to those normally used for the next higher voltage levels. No ionization is encountered at operating voltage.

CORROSION-RESISTANT, the outdoor type features General Electric's revolutionary Hy-Bute/60, combined with stainless steel accessories for even greater resistance to corrosion.

A "CERTIFICATE OF TEST" is tagged to each transformer you buy, certifying that the transformer has passed insulation and accuracy tests. Use of this certification can eliminate the time and expense of conducting acceptance tests, resulting in a bigger savings for you.

FOR FURTHER INFORMATION, write: Section 581-6, General Electric Co., Schenectady 5, N. Y., or call your nearest General Electric Apparatus Sales office.

GENERAL ELECTRIC

FANNER ARMOR RODS with the Superformed Spiral provide

EASIER FIELD INSTALLATION

GREATER GRIPPING STRENGTH

LONGER-LASTING PROTECTION

• EASIER FIELD INSTALLATION

"Superforming" of special spring-type wire at factory into uniform spirals that snap perfectly into place by hand without the use of tools . . . eliminates costly, haphazard field fabrication of armoring.

• GREATER GRIPPING STRENGTH

The "close-pitch" spiral of *"Superformed"* Armor Rods winds around conductor developing a permanent non-slip full length grip that is stronger and tighter than made by any other method of armoring.

• LONGER-LASTING PROTECTION

"Superformed" Armor Rods reduce conductor strain...prevent conductor pitting and wear . . . eliminate hazards of end clamps.

To get the best — specify Fanner *"Superformed"* Armor Rods. Get acquainted with the important savings they offer by writing for descriptive literature today.

CENTER-MARKED, COLOR CODED AND PACKED IN CONVENIENT CARTONS

Licensed for use under patent Nos. 2,275,019 and 2,587,521

Fine Fanner Superformed Products

THE FANNER MANUFACTURING COMPANY

Electrical Products Division

BROOKSIDE PARK • *Established 1894* • CLEVELAND 9, OHIO

Telephone: SHadyside 1-6000

AGENTS and DISTRIBUTORS IN PRINCIPAL CITIES

ARMOR RODS · LINEGUARDS · TAP ARMOR · PATCH RODS · FANNGRIPS
PLASTIC FANNGUARDS · PLASTIC INSULATING TUBINGS AND MOLDINGS

ACCOUNTING—Operation

Electric Oven Solves Damp Meter Card Problem

Damp meter cards are dried curl-free in an industrial electric oven at Indianapolis Power & Light Co. The drying takes an hour, but it readies the cards on rainy days for smooth processing through electronic accounting equipment.

The cards were formerly dried without applying heat, but they curled and became even more difficult to run through the machines.

DISTRIBUTION—Maintenance

Conveyor Cuts Labor Costs at Transformer Repair Shop

A. W. SHELHORSE, Supervisor, General Repair Shop, Georgia Power Co, Atlanta, Ga.

A swinging-beam electric hoist and a roller conveyor facilitate the handling of distribution transformers at Georgia Power Co's general repair shop. They replace warehouse trucks, reducing the labor cost of moving units by more than 50%. The conveyor also provides better housekeeping and a safer shop.

The hoist loads and unloads the transformers from trucks. The conveyor, rated 3,000 lb per roller, transports them around the shop.

(*More How to on page* 76)

POWERS *American*

"Earth-Master"

HYDRAULIC HOLE DIGGER

IDEAL FOR USE IN COMBINATION WITH "POLE-MASTER" SERIES PM-2 HYDRAULIC DERRICK

Earth-Master digs holes hydraulically . . . up to 9′ 4″ in depth. It will dig at various angles in most types of soil. The hydraulically-powered auger, traveling up and down on a twin-column support frame, is guided at all times — digs holes that are always straight, always clean.

The auger is raised and lowered by a reversible hydraulic motor; rotated in either direction by a separate hydraulic motor. Power is derived from a hydraulic pump driven by the truck engine.

There's plenty of "down pressure" for digging in hard soil . . . supplied by the drive motor and the downward thrust which can be applied to the support frame with the hydraulic derrick.

Digger controls are located beside derrick controls in right rear body compartment . . . giving operator full view of all digger and derrick movement. An automatic, self-resetting relief valve protects the digger and hydraulic system against overload.

Earth-Master is ideal for use with the Powers-American Pole-Master Series PM-2 Hydraulic Derrick. It can be installed on derricks now in use, or factory-mounted in conjunction with a Pole-Master Derrick on a Powers-American Line Body that fits your job needs. Standard augers up to 20″ in diameter can be furnished. Digger can be supplied with special Pengo Heads for digging where soil condition retards auger.

- Ready for use in seconds . . . at the flick of a control
- Digs holes that are always straight . . . always clean
- "Down pressure" to spare . . . for digging frozen soil or "hard pan"
- Easily removed and transferred to another vehicle
- Stows in cradle above body . . . does not increase overall body height or obstruct load area when used with Pole-Master Series PM-2 Derrick
- Can be used for digging on opposite side of fences
- Swings out of the way when derrick is to be used for setting pole

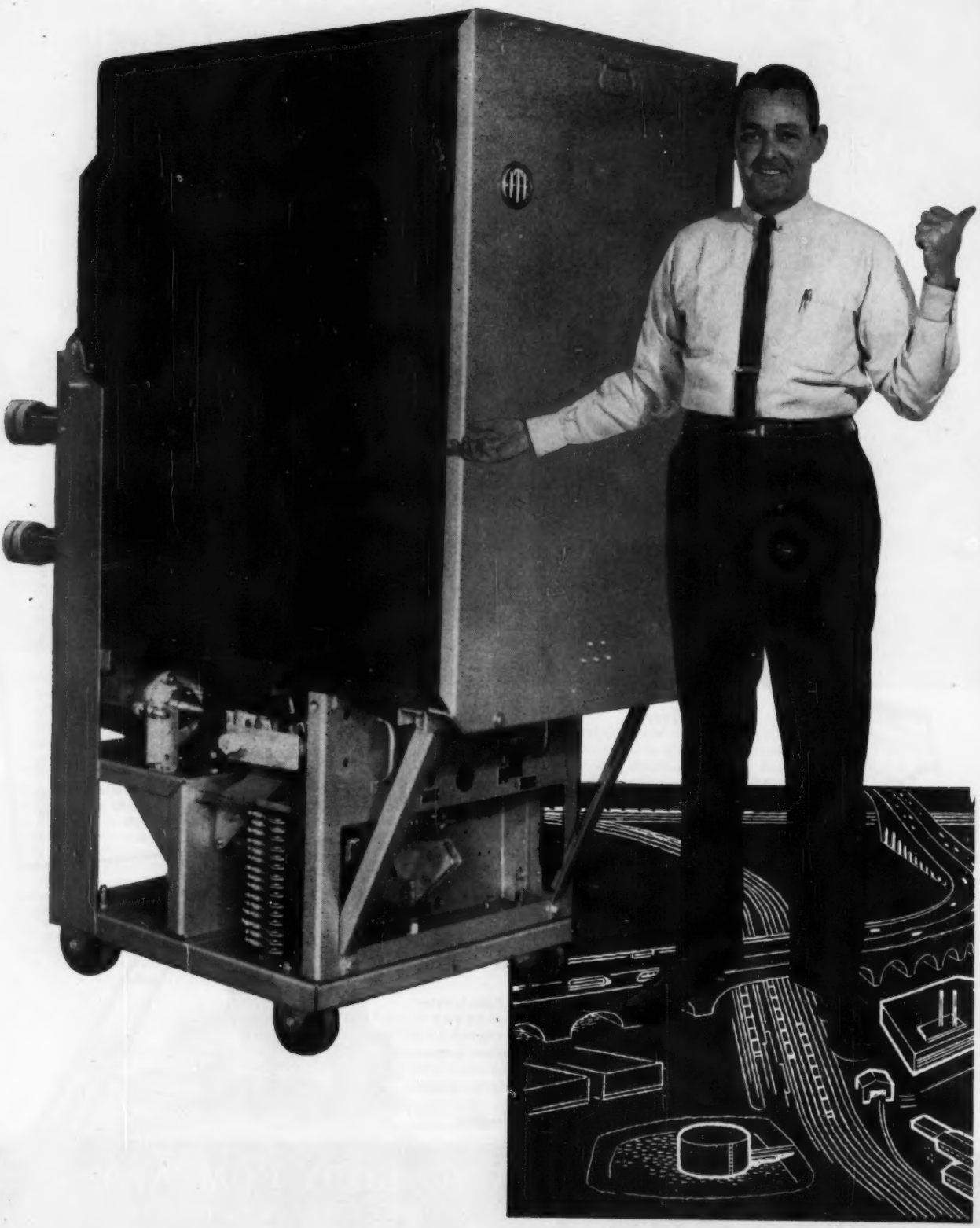
Support frame can be turned to various angles . . . extended to fit operating conditions.

Price information and descriptive literature will be sent upon request.

McCABE-POWERS AUTO BODY COMPANY

5900 NO. BROADWAY
ST. LOUIS 15, MO.

625 CEDAR STREET
BERKELEY 10, CALIF.

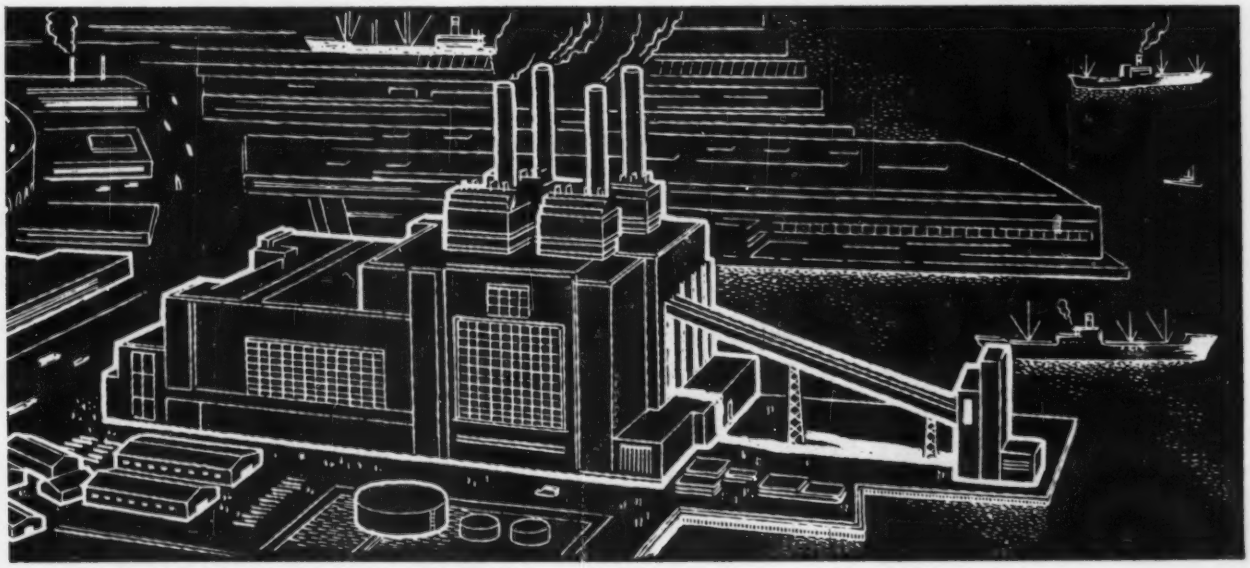


Now from I-T-E one million kva

15 kv metal-clad switchgear

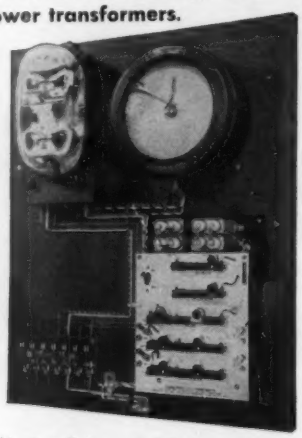
Enjoy all the safety, compactness, negligible maintenance, and economy of air magnetic circuit breakers even up in this new high range. You can do it now. Quality I-T-E metal-clad switchgear is available in million kva, 1200 and 3000 amp ratings for 1958 delivery. The first installation is scheduled for the new substation of a large Eastern power company. Other orders are being taken now. Write for complete technical information on your specific application. Switchgear Division, I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY
SWITCHGEAR DIVISION



Transformer Loss Compensator Saves you Money!

BECAUSE it provides an accurate means of measuring the energy and demands of high-voltage services at the low-voltage side of the power transformers.



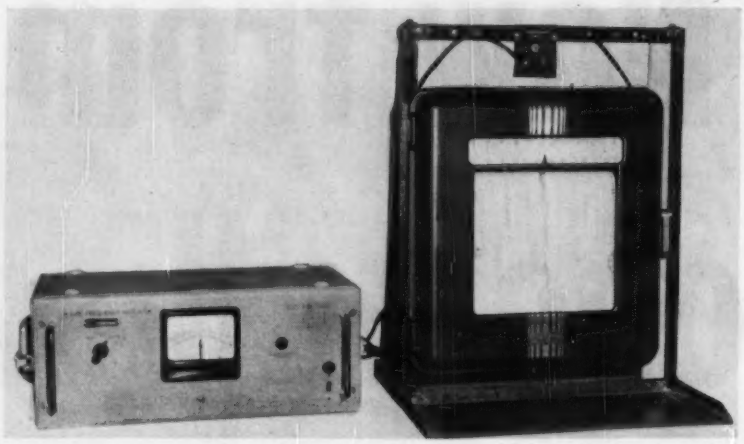
This installation at 2.3 kv saved about $2600 compared with 34.5 kv metering; it saves about $5500 over metering at 69 kv.

THE TESCO compensator adds to the registration of the watthour meter an amount equal to the sum of the iron and copper losses of the transformer bank. It may be used with practically any type of watthour meter and . . . importantly . . . no changes are made in the meter itself, either structurally or in adjustments . . . It is produced in two and three element types for use with two-element or three-element meters on any type circuit.

Some of the Users . . .

Phila. Electric Co. Penna. Power & Light Co. Texas Power & Light Co. U. S. Bureau of Recl. Public Service Co. of New Hampshire. Utah Power & Light Co. Northern States Power Co.

Get your book now
FREE
Detailed information on operation, installation, applications. Write for Bulletin NO. 63-A.
EASTERN SPECIALTY CO.
PHILADELPHIA 40, PA.



LINE FREQUENCY DRIFT INDICATOR, adopted by Con Edison, is used in conjunction with a frequency recorder, reading out the latter's deviations from 60.0 cps

Provides Frequency Deviation

JOSEPH COWAN, Test Supervisor, Test Bureau, Meter & Test Division, Consolidated Edison Co of New York, Inc, New York, N. Y.

A highly accurate frequency drift indicator, developed in Munich, Germany, is used by the Consolidated Edison Co of New York, Inc, for recording system frequency. Such an indicator could be adapted readily to function as the control in system interconnection equipment now in use on some systems.

Tie-line load control usually is based on deviation of system frequency from a reference standard frequency, or from electrical circuit constants providing a current function proportional to the frequency deviation. Commercial availability of a precise reference power frequency has been heretofore limited. Cost of equipment for furnishing precise standards has been high. The unit adopted by Con Edison overcomes these limitations.

Output Parallels Drift

The indicator has a dc output directly proportional to the system frequency drift from 60 cps. Polarity of this output changes with the sign of the frequency drift. Output is recorded on a strip-chart millivolt recorder with a scale and chart marked in cycles.

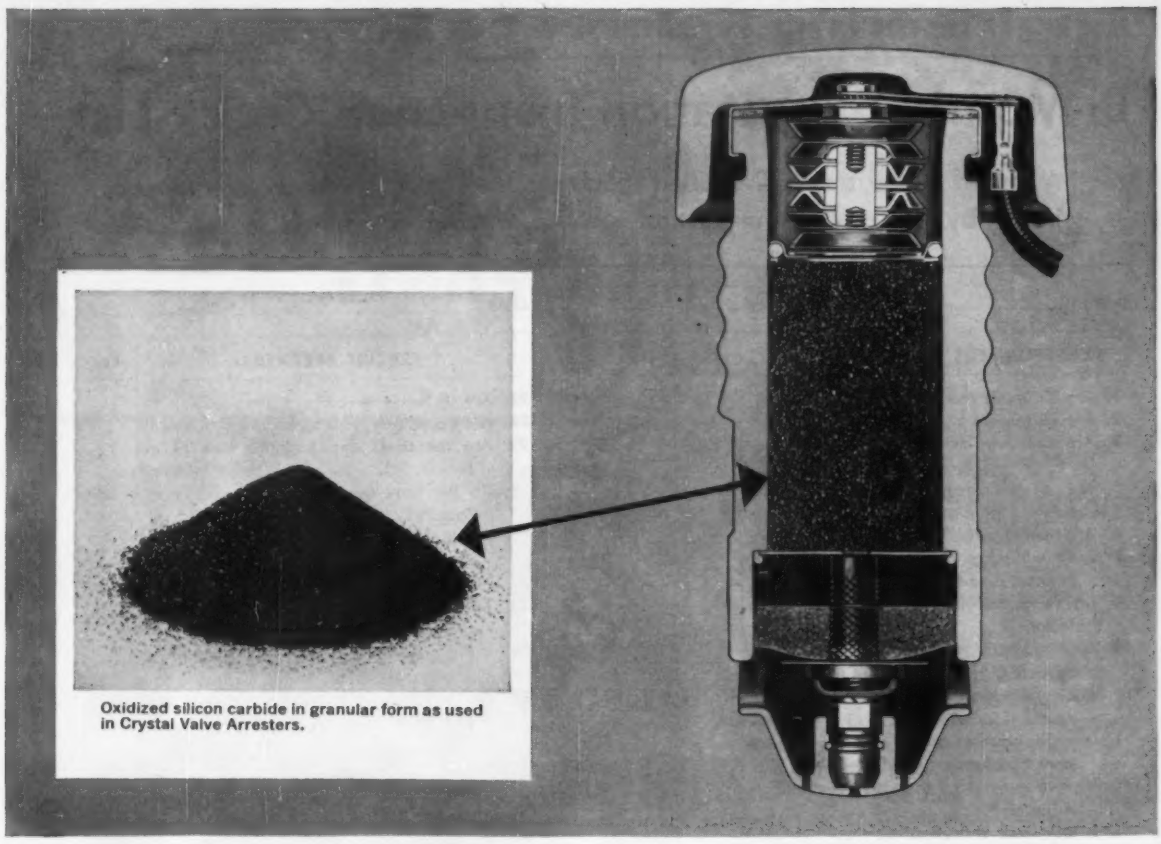
System frequency to be measured is multiplied by 80 through the indicator's several multiplier stages. The resulting approximate 4,800 ($\pm$) cps then is mixed with a 5,000-cps signal generated by a crystal oscillator. Wave form of the resultant 200 ($\pm$) cps is changed electronically to a trapazoidal wave of constant amplitude independent of frequency.

Output Zero at 60 cps

Current resulting from the discharge of this voltage through a fixed capacitor is a function of the frequency of the mixer output. It is rectified and biased so that resultant dc output is zero for a mixer output of 200.0 cps (input frequency of 60.0 cps) and is proportional to the variation of the input frequency from 60.0 cps.

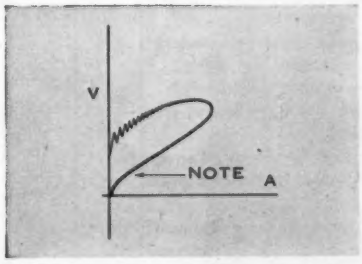
Two Ranges Available

The indicator has a selector switch for a full-scale range of $\pm$0.5 and 1.0 cps. Its output circuit supplies 10 ma up to 100 v for full scale of either range. The drop across a set of resistors in the output circuit can be applied to the strip-chart recorder. These resistors were so selected that, when the indicator is on the $\pm$0.5-cps range, the recorder can be set for either 60 $\pm$0.5 or 60 $\pm$1.0 cps.

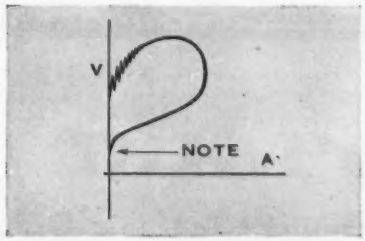


Oxidized silicon carbide in granular form as used in Crystal Valve Arresters.

Why CRYSTAL VALVE ARRESTERS outperform all other lightning arresters



Volt-ampere curve of ordinary valve element. Note that current is not cut off until voltage approaches zero.



Volt-ampere curve of Crystal Valve element. Current is cut off at voltage above zero.

No other lightning arrester has the oxidized silicon carbide valve element that spells the difference in performance for famous Crystal Valve Arresters.

This valve element, composed of optimum-sized granules of oxidized silicon carbide, exhibits unusually high resistance recovery after lightning surges, and very high conductivity to impulse response. As shown by the volt-ampere curves at left, Crystal Valve Arresters cut off current at a voltage above zero, giving a more positive cut-off than is possible with other valve materials.

This balanced combination of resistance and conductivity in Crystal Valve Arresters eliminates the need for a special-type gap to interrupt heavy follow currents; prevents fuse-coordination problems and end-turn failures in transformers. Finally, the Crystal Valve Arrester can cut off higher voltages without failure.

Get the whole story about the efficiency of Crystal Valve Arresters. Call your nearest Delta-Star office, or write *Delta-Star Electric Division, H. K. Porter Company, Inc., 17th & Cambria Sts., Philadelphia 32, Pa. District offices in principal cities.*

H. K. PORTER COMPANY, INC.

DELTA-STAR ELECTRIC DIVISION

Connors Steel, Delta-Star Electric, Disston, Leschen Wire Rope, Quaker Rubber, Refractories, Riverside-Alloy Metal, Vulcan Crucible Steel, W-S Fittings, H. K. Porter Company (Canada) Ltd.

Engineering Reference Sheet

NO. 58-1

Bi-Monthly Substation Inspection Check-List

Adapted from bulletin entitled "Substation Inspection and Maintenance," issued by REA. Visual inspection is made without de-energizing substations*

Station _____ Date _____ Time _____

TRANSFORMERS AND REGULATORS	Yes	No
1. Are oil levels correct?		
2. Are oil gauges in satisfactory condition?		
3. Are tanks free of oil leaks?		
4. Do temperatures appear satisfactory?		
5. Are all thermometer maximum indicators below 75 F.?		
6. Are thermometers in satisfactory condition?		
7. Are the bushings clean and do they appear in good condition?		
8. Do regulator mechanisms operate satisfactorily?		
9. Are regulator position indicating lights operating properly?		
10. Are regulator position indicator glass covers intact?		
11. Is appearance of station power and instrument transformers satisfactory?		
12. Have you reset all thermometer maximum indicators?		
13. Is load limit indication less than full boost or buck?		
14. Are demand meter readings below 95%?		
15. Do control cabinet gaskets seal properly against weather?		
16. Are regulator counter readings recorded in "Remarks"?		
ARRESTERS, CAPACITORS, AIR-BREAK SWITCHES AND DISCONNECTS		
17. Do arresters appear undamaged?		
18. Do capacitor tanks and bushings appear undamaged?		
19. Do capacitor fuses appear to be in satisfactory condition?		
20. Are all switch and disconnect contacts fully closed?		
21. Do switch and disconnect insulators appear in good condition?		
BATTERY AND CHARGER		
22. Are water levels correct?		
23. Are cell tops clean and dry? (Test with finger)		
24. Are terminals and connectors clean and do they appear satisfactory?		
25. Is charger operating satisfactorily?		
26. Charger voltage ____; Amperes ____; Pilot cell temp.		

CIRCUIT BREAKERS	Yes	No
27. Are oil levels correct?		
28. Are the oil gauges in satisfactory condition?		
29. Are the tanks and bushings free of oil leaks?		
30. Do the tank temperatures appear satisfactory?		
31. Are bushings clean and do they appear in good condition?		
32. Are all space heaters in operation?		
33. Are counter readings recorded in "Remarks" and relay targets reset?		
34. Are all indicating lamps operating properly?		
35. Are switch housings, control cabinets and gaskets in good condition?		
GENERAL		
36. Is all the equipment grounded?		
37. Are fence and all gates grounded?		
38. Are switch sticks in good condition and properly stored?		
39. Are all phases and operating circuits properly identified?		
40. Are cabinets and cubicles clean and orderly?		
41. Is yard clean?		
42. Do gates lock properly?		
43. Are ground detector lights of equal brilliance?		
44. Do high voltage fuses appear satisfactory?		
45. Are fuses properly stored?		
46. Do all connections appear satisfactory?		
47. Are exits, driveways and walkways free of all obstructions?		
48. Is substation enclosure free of stored equipment and tools (except fuses and switch sticks)?		
49. Have all burned-out lamps been replaced?		
50. Is substation overhead ground wire in good condition?		

INSPECTED BY .....

REMARKS: .....

.....

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.....

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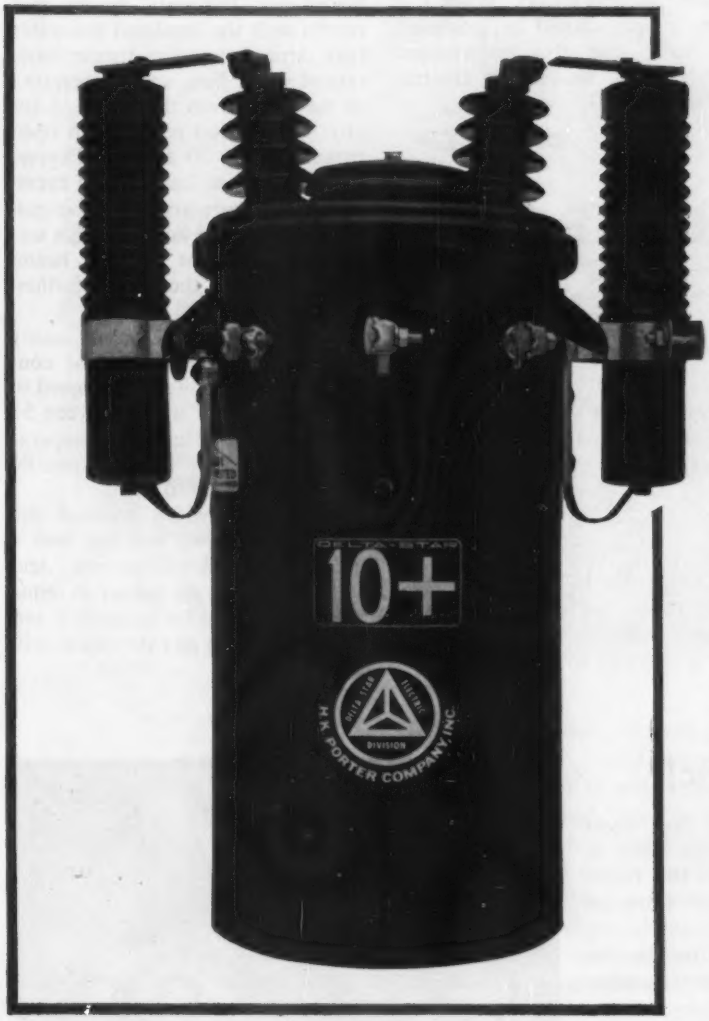
*CAUTION—All observations should be made without approaching live (energized) parts nearer than the following minimum safe distances: 750 to 3,500 v—1 ft; 3,501 to 10,000 v—2 ft; 10,001 to 50,000 v—3 ft; 50,001 to 130,000 v—5 ft; 100,001 to 250,000 v—10 ft.

NOW... DELTA-STAR creates a new line of Overall Self-Protected Transformers*...



GIVES YOU EVERY MODERN DESIGN FEATURE

Single-Phase, 3kva—100kva
15,000 volts and below

Delta-Star now offers you the latest, most advanced features in OVERALL SELF-PROTECTED transformer design. This modern transformer protects itself against failures from both internal and external causes. Here are only a few of the principal features. Operating handle sequence prevents accidental tripping. Breakers offer maximum available overload capacity. Safeguard fuse easily replaced. Crystal valve arresters limit line surges. Entire unit conforms to NEMA and ASA standards.

Delta-Star engineering and design is backed by extensive experience in power and distribution equipment. With this background of knowledge and skill, Delta-Star engineers have created an exceptional OVERALL SELF-PROTECTED Transformer—from concept to shipping crate. They have utilized the most modern materials and methods to engineer a fine quality product.

Send for catalog containing complete information on the line of Delta-Star OVERALL SELF-PROTECTED Transformers. Write to: Delta-Star Electric Division, H. K. Porter Company, Inc., 17th and Cambria Streets, Philadelphia 32, Pa.

***PATENTS APPLIED FOR**

H. K. PORTER COMPANY, INC.

DELTA-STAR ELECTRIC DIVISION

Connors Steel, Delta-Star Electric, Disston, Leschen Wire Rope, Quaker Rubber, Refractories, Riverside-Alloy Metal, Vulcan Crucible Steel, W-S Fittings, H. K. Porter Company (Canada) Ltd.

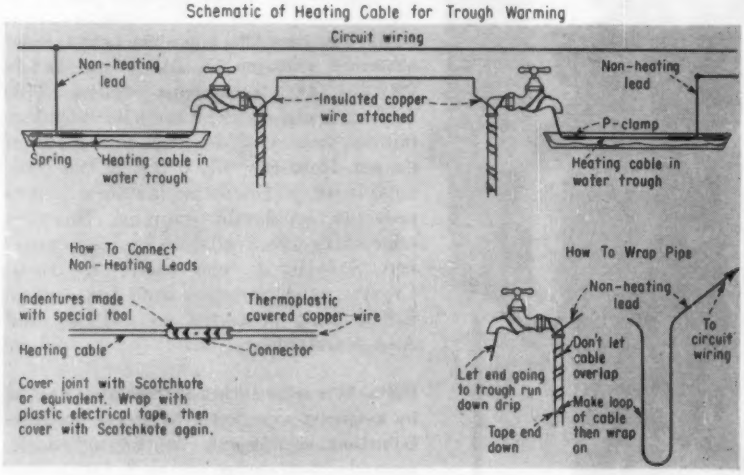
APCO Likes Poultry Water-Warming Load

W. L. BAKER, JR., Agricultural Engineer, Alabama Power Co, Birmingham, Ala.

Down here in Alabama we're finding that winter poultry water warming is a very desirable load. It is also a growing one. In 1956 farmers in our territory put in more than 100 kw of warming equipment; in 1957, nearly 150 kw went in.

Most common method of heating a trough-type waterer is with flexible electric heating cable which can be safely immersed in water. Such moisture and heat-resistant cable is usually covered with lead, plastic, silicone rubber, or neoprene and is available in lengths from 3 to 160 ft. When installed in troughs it satisfactorily prevents freezing. However, it must be put in carefully to avoid insulation breaks. When it is used, troughs should be grounded. The cable can also be wrapped around pipes to prevent freezing (see illustration).

Schematic of Heating Cable for Trough Warming


Circuit wiring
Non-heating lead
Insulated copper wire attached
Non-heating lead
P-clamp
Spring
Heating cable in water trough
Heating cable in water trough
How To Connect Non-Heating Leads
Indentures made with special tool
Thermoplastic covered copper wire
Heating cable
Connector
Cover joint with Scotchkote or equivalent. Wrap with plastic electrical tape, then cover with Scotchkote again.
How To Wrap Pipe
Non-heating lead
To circuit wiring
Don't let cable overlap
Let end going to trough run down drip
Make loop of cable then wrap on
Tape end down

A second method of water warming uses the insulated hot-water tank. It has the dual advantage of allowing medication or other additives to be mixed with the water before sending it to the trough, and it is permanent, whereas flexible heating cable usually has to be replaced every few years. We find that results with the insulated hot-water tank depend on room temperature, rate of water flow, and temperature of the water from the heater. Usually we get good results with open troughs up to 70 ft long. Beyond that length heat loss may be excessive. For longer troughs, we've gotten good results by connecting a second insulated pipe from the heater to the point in the trough farthest from it.

Some farmers still warm poultry water with heated individual containers. These units are designed to keep 12-15 qt of water between 55 and 60F even when room temperatures dive to 0F. They are usually rated from 70 to 250 w.

No matter which method the farmer prefers, we find the load a good winter valley-filling one. And when we talk to the farmer in terms of what it can do for his poultry and egg business, it is an easy load to sell.

'Those Trains Are Terrific!'

It was an eight-year old boy who said that, while watching the annual Christmas display in the lobby of Cincinnati Gas & Electric Co's building. The trains highlighted the theme of this year's display—"Someone You Know Wants Something Electrical."

But there were other electrical displays besides the train. Among them: Appliances, housewares, sewing machines and lighting.

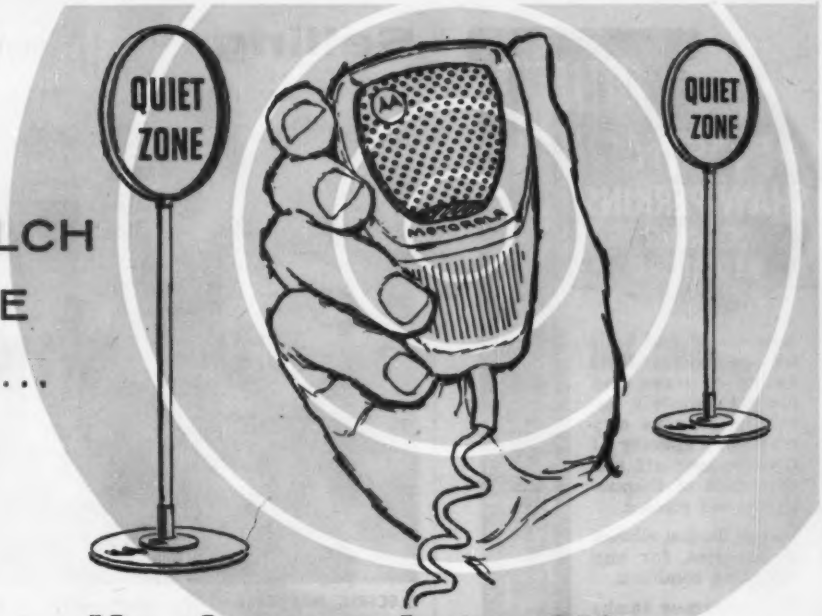
CG&E kicked off the train display in an old but sure-fire publicity-getting way. It had Cincinnati Mayor D. D. Clancy throw the switch that set the miniature B&O railroad in motion. Company president E. S. Fields and board chairman W. C. Beckjord, were also present.

The Cincinnati Post ran a daily coupon-clipping contest for kids in which coupons had to be deposited in the lobby of the utility building. Winners each day were made "Honorary Christmas Engineers," and on the final

day the winning boy received an electric train and the winning girl a complete toy kitchen. CGE estimates the display drew 100,000 people, mostly "boys", six to 60.

(*More Selling on page* 82)

NEW
MOTOROLA
DUAL-SQUELCH
PRIVATE-LINE
2-WAY RADIO...



silences all channel traffic except your own messages

POWER

PRIVATE-LINE radiophone is now available in T-POWER (shown above), which features a completely transistorized power supply, as well as TWIN-V radio with 6/12 volt operation.

Get the complete facts about this startling new type of 2-way radio. Write today for these 2 new folders on PRIVATE-LINE radiophone.

Now, with the new Dual-Squelch PRIVATE-LINE radio, you get all the benefits of improved PRIVATE-LINE operation . . . *plus* easy integration for mixed fleets and monitor-before-transmit.

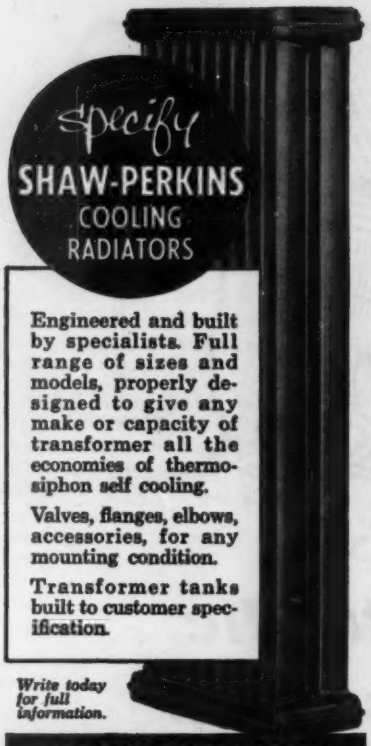
Because PRIVATE-LINE radio is quiet except when receiving a call from another radio in your own system, you eliminate all the "channel chatter." It's much like having the frequency all to yourself. You benefit by reducing the number of missed or misunderstood messages . . . operator fatigue is reduced . . . overall efficiency is increased.

Dual-Squelch PRIVATE-LINE radio gives you these basic features . . . and more. Now you can make a gradual changeover to PRIVATE-LINE operation. During the transition period, your messages can be received by both Motorola conventional and PRIVATE-LINE radios. No longer is it necessary to make the complete changeover to PRIVATE-LINE operation at the same time. And with the new Dual-Squelch operation, you can have manual selection or optional automatic monitoring of the channel before transmitting.

Before you select your 2-way radio, you'll want to investigate Motorola Dual-Squelch PRIVATE-LINE radio.

MOTOROLA PRIVATE-LINE RADIOPHONE

MOTOROLA Communications & Electronics, Inc., A Subsidiary of Motorola, Inc., 4501 Augusta Boulevard, Chicago 51, Illinois


specify
SHAW-PERKINS
COOLING
RADIATORS
Engineered and built by specialists. Full range of sizes and models, properly designed to give any make or capacity of transformer all the economies of thermo-siphon self cooling.
Valves, flanges, elbows, accessories, for any mounting condition.
Transformer tanks built to customer specification.
Write today for full information.
SHAW-PERKINS
MANUFACTURING COMPANY

Two New Minerallac Quality Products Designed for Jobs Too Heavy for Standard Jiffy Clips
MINERALLAC
Heavy Duty AND Medium
JIFFY CLIPS
JIFFY
Also available without mounting hole for use with gun.
THIS INVERTED RIB DOES THE JOB
patent pending
Made of heavier materials! Has exclusive inverted rib, that provides more strength at the bend of clip . . . and, of course, adds the benefits of famous "Snap On" feature!
In stock in Zinc-Plated Steel for Thin Wall or Rigid Conduit up to 6". (Hot Dipped Galvanized may be obtained on order) Can be substituted for malleable clips.
Order From Your Electrical Wholesaler
SEND FOR LITERATURE
MINERALLAC ELECTRIC COMPANY
25 North Peoria St. Chicago 7, Ill.
MINERALLAC

ELECTRIC HEATER and insulation surround Portage Manley's Thomas Manley and Wisconsin Power & Light's W. K. Potts as they inspect a new grease pit

Electric Heat Saves Stack of $

C. E. DOPKE, Industrial Power Engineer, Wisconsin Power & Light Co, Madison, Wis.

It was a big first-cost saving that helped Wisconsin Power & Light sell 270 kw of electric heating to Portage Manley Sand Co of Portage, Wis.

Portage Manley processes silica sand for the making of glass. In 1956 the company needed a building for overhauling and repairing its trucks and tractors. The building, now erected, measures 60 by 120 ft. It had to be located near a transformer bank serving the processing needs of adjacent buildings and pits.

Stack Eliminated

If conventional heating had been used in the new repair building, it would have required a tall stack located near the bank. Besides this expense, the bank might also have had to be relocated. Instead, P-M vice president Thomas Manley decided on our advice to go to electric heat and save the high cost of the stack.

Here's the way the heating system is laid out:

Insulation—Aluminum bat was used throughout, similar to that shown in the illustration above.

Heaters—Six 45-kw, 3-phase, 480-v, blower-type units were used. Installed at each door, they automatically cut in when doors are opened, reducing heat loss. Heaters are connected through relays to prevent operation of more than two units in any 15-min period, thus lopping off any possible peaks on the plant's system. (This system, incidentally, is relatively large. Demands average 750 kva, with average pf of 98%. It has more than 800 hp in motors. The substation serving the building contains three 167-kva transformers. Primary distribution voltage for the entire plant is 12 kv.)

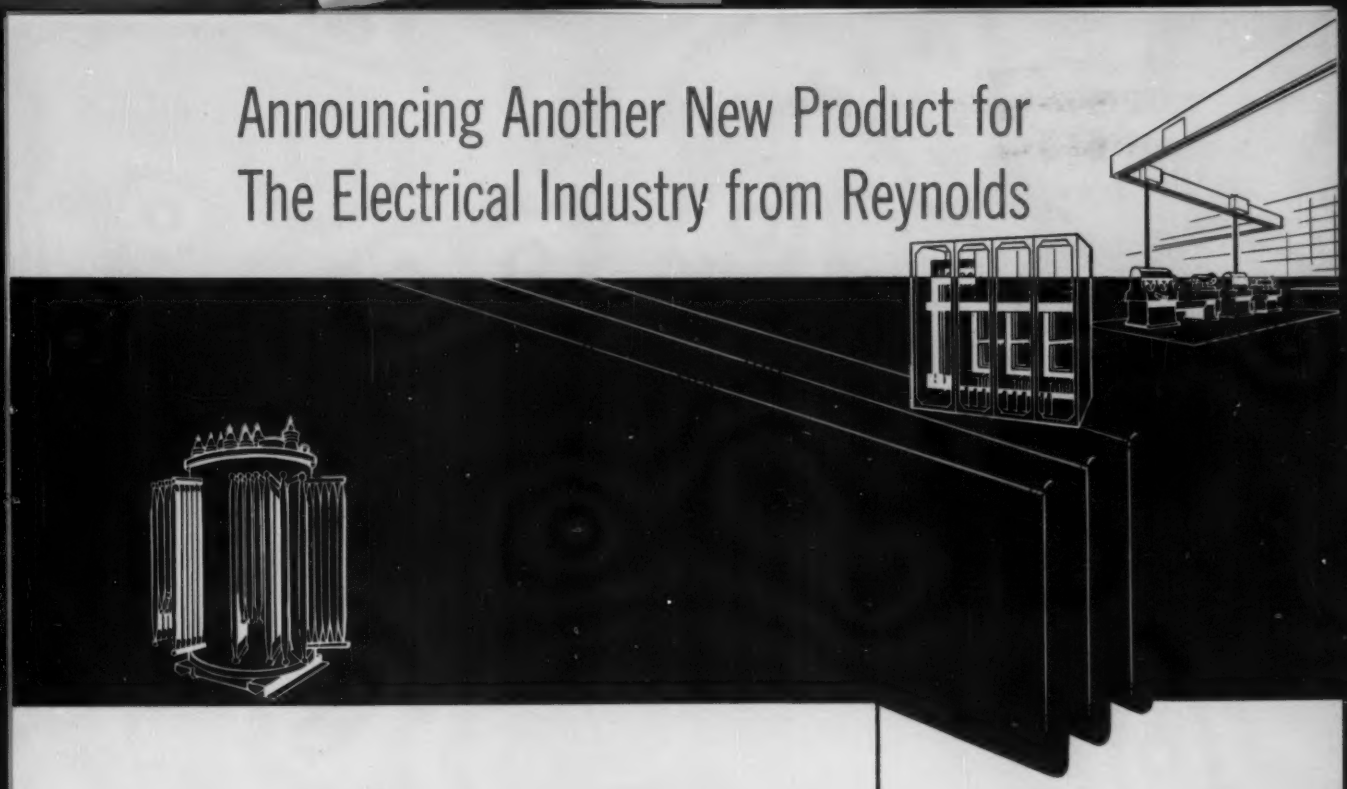
Results—The heating system keeps the repair building at about 65F during working hours. Degree-days in this area average 7207 per year.

Company Bought Additional 45 kw

How do P-M officials like their electric heating? Well enough, apparently to have bought 45 kw more and installed it in a new lubrication building. Construction and insulation details are similar to those used in the larger repair building (see illustration).

(*More Selling on page* 85)

Announcing Another New Product for
The Electrical Industry from Reynolds



SILVER PLATED aluminum BUS BAR

Reynolds new Silver Plated Bus Bar offers substantial economies over unplated copper bar . . . from 35 to 50 % lower in price. It should be of prime interest to manufacturers of metal enclosed switchgear, power transformers, bus duct, panel boards and other electrical equipment, and to electrical contractors for the following reasons:

It is attractive in appearance, light in weight and represents a sizeable savings over commonly used bare or plated copper conductors.

Bolted joints can be made with no prior preparation of surface and no joint compound.

Silver plating provides a surface readily tinned, soldered or brazed.

Silver plating permits a higher operating temperature in many installations according to electrical codes.

It provides minimum contact resistance for sliding or pressure contacts.

Turn page for more information.

The Finest Products
Made with Aluminum
are made with
REYNOLDS ALUMINUM

TECHNICAL DATA ON REYNOLDS SILVER PLATED ALUMINUM BUS BAR

A Development of Reynolds Research Laboratories

One of the most persistent problems in the application of aluminum busses has been in the making of reliable electrical connections with simple and inexpensive techniques. This problem is always related in one way or another to the oxide film on the surface of the aluminum, and the possibility of galvanic corrosion between aluminum and copper to which it might be connected. Silver contact surfaces are generally recognized as the most effective means for insuring superior contact reliability.

Silver plated aluminum bars have not heretofore been commercially available and no industry standards have been established for the quality of silver plating. Since industry practices varied so widely, the Reynolds Research Laboratories established the following requirements for silver plated aluminum bus conductors:

- ★ **Perfect adhesion between the plating and the base metal . . . prevents blistering or peeling off under service conditions.**
- ★ **Free of porosity . . . ordinary platings on aluminum tend to be porous, could lead to galvanic corrosion of the aluminum under certain conditions.**
- ★ **Good resistance to abrasion . . . plating must remain intact even though "wiping" contacts may be repeatedly made.**
- ★ **Maximum formability . . . forming operations can be performed without danger of peeling.**
- ★ **Plating costs must be low . . . offer substantial savings over *bare* copper bus.**
- ★ **Plating process must be applicable to all aluminum alloys commonly used for aluminum bus bars.**

REYNOLDS SILVER PLATED ALUMINUM BUS CONDUCTORS MEET ALL OF THE ABOVE REQUIREMENTS!

In addition, a performance specification incorporating appropriate production quality control testing procedures has been developed to insure that the finished products will have uniformly high quality platings.

COMPARISON OF RECTANGULAR SILVER PLATED ALUMINUM BUS BARS WITH UNPLATED COPPER BARS

60 Cycle AC Ampacity (1) (Current Carrying Capacity)	Aluminum Alloy 6101-T62 30°C Rise	Copper 30°C Rise	Cost per Foot Silver Plated Aluminum 6101-T62	Cost per Foot Unplated Copper (2)
385	⅜" x 1"		$ .30	
395		¼" x 1"		$ .54
420	¼" x 1½"		$ .31	
925	⅜" x 3"		$ .85	
960	¼" x 4"		$ .81	
970		¼" x 3"		$1.59
1350	¼" x 6"		$1.21	
1405	⅜" x 5"		$1.40	
1485		¼" x 5"		$2.20

(1) Ampacity ratings based on standard indoor conditions.

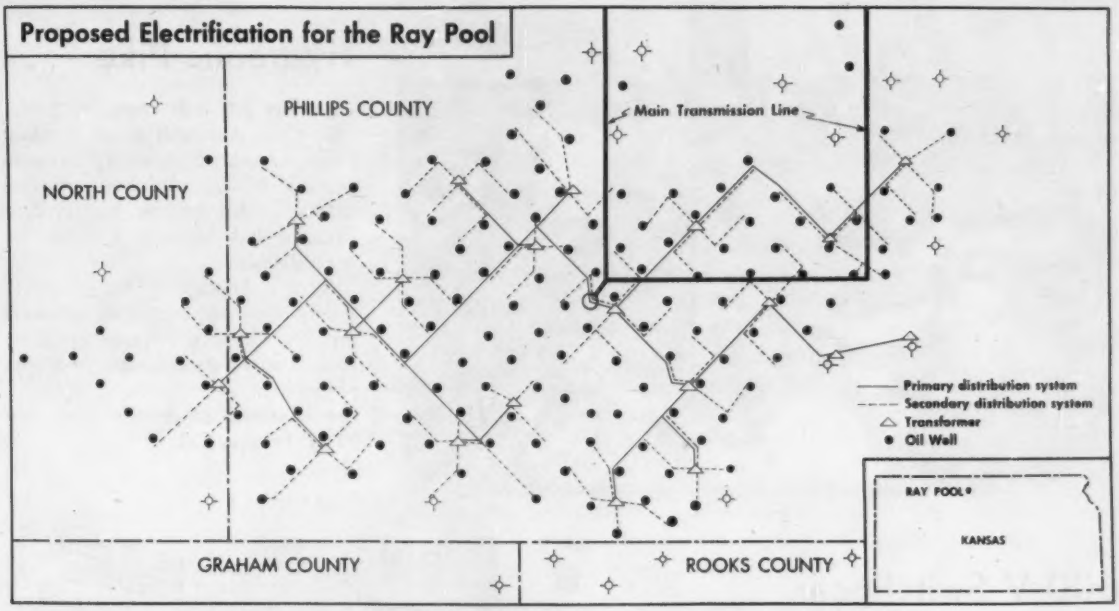
(2) Based on October 8, 1957, copper prices.

For details and assistance from Reynolds Engineering Service on your products or problems, call your local Reynolds office or write *Reynolds Metals Company, P.O. Box 1800-EW, Louisville 1, Ky.*

IMPROVING ELECTRICAL SYSTEMS FROM POWER SOURCE TO END USE

The Finest Products Made with Aluminum are made with REYNOLDS ALUMINUM

Watch Reynolds All-Family Television Program "DISNEYLAND", ABC-TV.



Serving 145 well and brine pumps in northern Kansas field, . . .

Oil-Well Electrification Saves $56,000

A major oil-field electrification scheme is now in full swing in the Cities Service Co's Ray Pool in northern Kansas. All production facilities in the field, including 139 oil-well pumps and six salt-water disposal pumps, are being converted to purchased power in an undertaking that will save Cities Service an estimated $56,000 per year. Savings over the 15-yr estimated pool life will be at least $840,000. With an investment of $195,000, the project is expected to pay for itself in just over three years.

Prime movers for the wells vary from 3 to 10 hp, with the majority in the 5 to 7.5-hp range. Salt-water pumps are 3 to 75 hp. Each motor will be equipped with a time clock for interrupted operation.

Primary Distribution is 13.2 Kv

Western Light & Telephone Co serves the pool from a 33.2-kv loop transmission line. Cities Service is installing a 13.2-kv primary distribution system. Twenty-one transformer banks, most of them 3-phase 25-kva units, will convert to 440-v 3-phase secondary. All distribution will be No. 2 ACSR. Each well will be equipped with automatic restart and with lightning, overload, and single-phase protection.

Cables will have a 70-ft clearance from each well head and 100 ft from tank batteries. Service to basic sediment and burning pits is from overhead lines. Motor and control power is supplied from underground conduit. The entire electrical system was designed by Cities Service.

One of the biggest boosters of oil-field electrification, Cities Service favors electric power because of economies in maintenance and other long-term savings. For example, cost of generator maintenance on the Ray Pool gas-engine system has been running about $9,500 per year; gas engine maintenance, about $13,000 annually. Both expenses will be elminated by electrification, along with about $3,000 per year for lubrication oil.

Similarly, expenditures for fuel gas, which the company buys locally, will drop from $57,000 to $13,000. These and other substantial savings will more than offset the estimated $43,000 electric bill and an increase of $5,100 in electric motor maintenance.

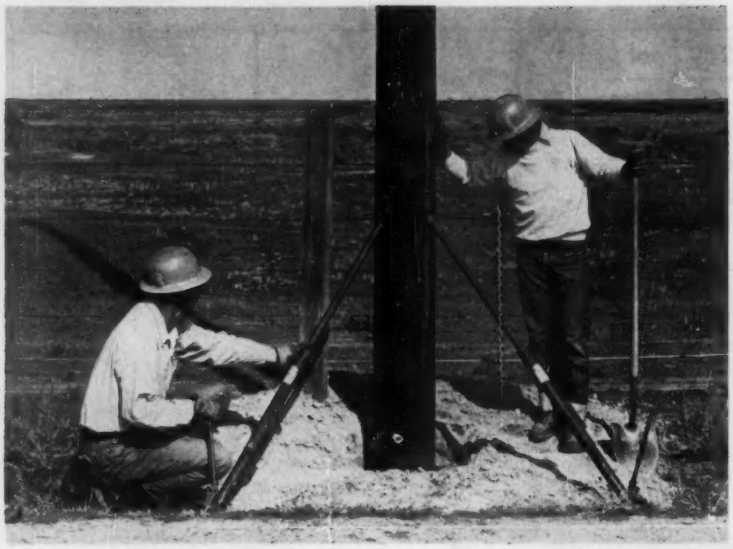
Cities Service had previously converted 31 wells in this pool, generating its own power. In all, it has electrified more than 1,000 wells in the past two years, now has 2,003 such units. Installed horse power has risen from 10,163 in 1955 to 17,790 hp today. About 20% of its wells are on purchased power, an increase of 400% since 1950.

Performance Record Good

Moreover, the electrified wells have turned in a good performance record, which Cities Service attributes to the exacting specifications it requires for all such installations. All motors are double insulated to withstand the cold weather on the plains. The results speak for themselves: in blizzards that hit the Texas panhandle fields last March, Cities Service had only two burnouts in the 243 motors it has in that area.

At the same time, the company has been able to reduce the average per well horsepower from 11 to 8.9. According to a company engineer, the savings from more exacting horsepower requirements are over $100,000.

New Equipment



Hydraulic Pike . . .

. . . has 3,000-lb capacity, 18-in. lift. One pair will align heaviest pole. Operated as easily as auto jack, it is very useful in crowded quarters. Known as the Hydro-Pike, it has been field tested by several utilities.

Tool is 51-in. long, weighs 28 lb. Safety cap on pike end prevents injuries. On hard surfaces, auxiliary foot assures safe footing, proper alignment.

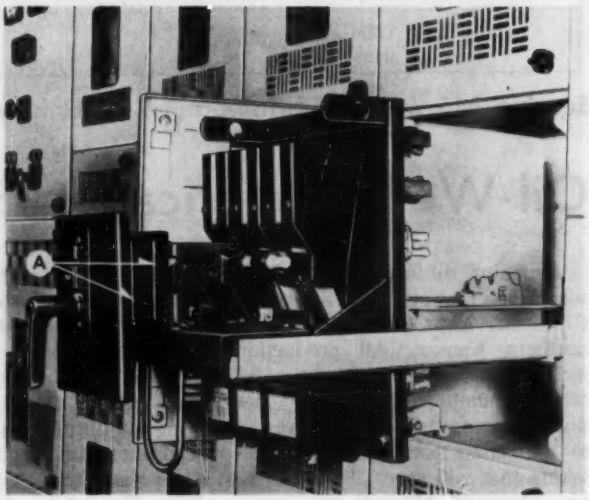
San Joaquin Hydraulic Co, 546 M St, Fresno, Cal.

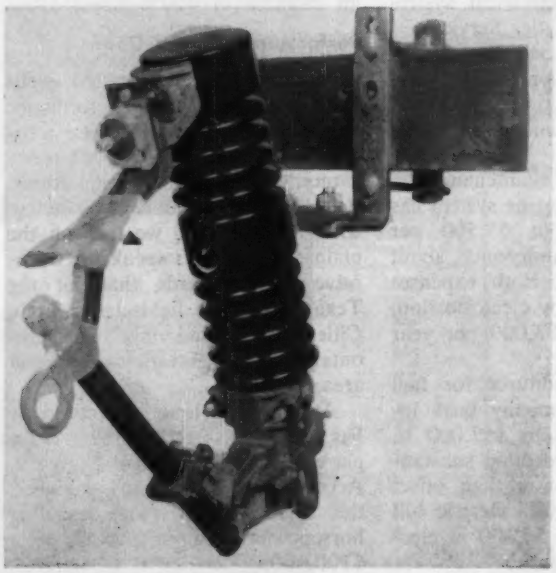
600-V Switchgear . . .

. . . allows breaker door to be shut with breaker in disconnected, test, or connected position. Two white lines on side of mechanism indicate position of breaker at a glance (see "A" in illustration). When it is closed, both lines show; in test, only one is visible; when connected, neither can be seen.

Designated Type DB, it is available for 15 to 4,000 amp, with interrupting ratings from 15,000 to 100,000 amp. Three-position feature is safe and convenient for personnel, offers protection for breaker. In emergency, units can be interchanged with earlier models.

Westinghouse Electric Corp, P. O. Box 2099, Pittsburgh 30, Pa.



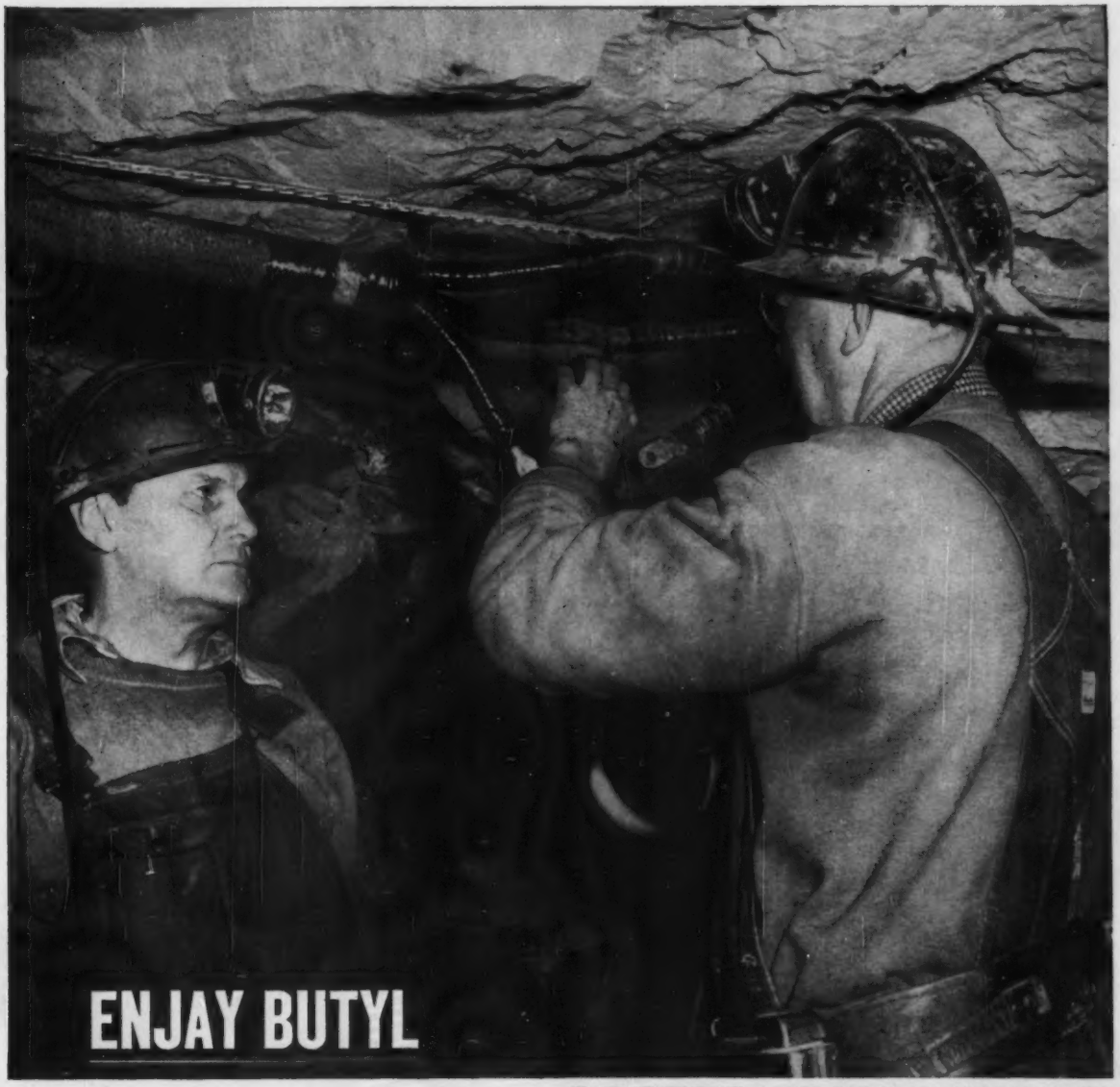


Heavy Duty Cutout . . .

. . . has twice the capacity of its predecessor. Redesigned fuse link holder boosts rating of 7.7-kv unit from 5,000 to 10,000 amp; raises 15-kv line from 4,000 to 8,000 amp. Made of tough fiber glass with polyester resin reinforcement, the holder has an expendable-cap action. For low-current faults, gases are vented downward; for high current faults, both up and down. Holders are interchangeable with previous models.

General Electric Co, Schenectady 5, N. Y.

(*More New Equipment on page* 90)



electrical wonder rubber OFFERS TRIPLE VALUE

Performance! Versatility! Economy! In all three, Enjay Butyl is the world's outstanding rubber value. In laboratory tests, and a wide variety of applications, no other rubber has matched Enjay Butyl's ability to resist ozone and corona, impact and abrasion, moisture and weathering . . . properties that make Enjay Butyl-made products *outstanding* performers.

Underground service cables, transformer housings, high-voltage industrial cables . . . in these, and many other electrical applications, Enjay Butyl outperforms and out-lasts *all other* types of rubber, synthetic *or* natural. *Low-in-cost* and *immediately available*, this truly wonder rubber may well be able to cut costs and improve performance in *your* products. For further information, and for expert technical assistance, contact the Enjay Company.

ENJAY

Pioneer in Petrochemicals

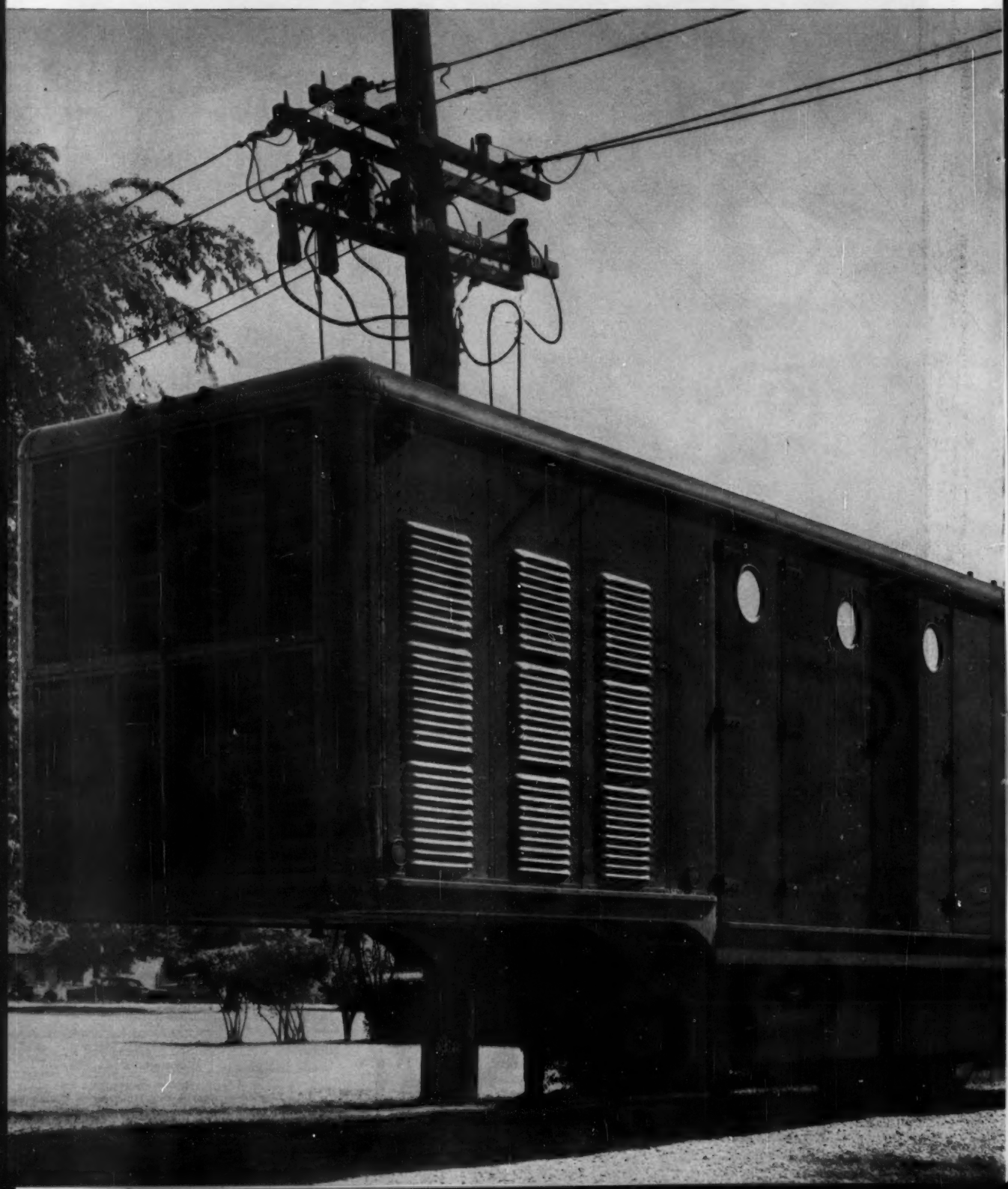
ENJAY COMPANY, INC., 15 West 51st Street, New York 19, N. Y.

Akron • Boston • Chicago • Detroit • Los Angeles • New Orleans • Tulsa

ENJAY BUTYL

Enjay Butyl is the greatest rubber value in the world . . . the super-durable rubber with *outstanding* resistance to aging • abrasion • tear • chipping • cracking • ozone and corona • chemicals • gases • heat • cold • sunlight • moisture.

Line relocation



need not be costly

Not, that is, when work can be completed during regular hours and without interrupting service. And many utilities are doing just that—paring the high cost of line relocation and other maintenance and repair needs—with versatile Electro-Mobile generating units.

For example, a 500 kw trailer like the one shown here can travel most anywhere, pick up a load in minutes. Crews can do their work faster, at lower cost, and all the while *normal service* is maintained.

Further, these units can be utilized as an immediate source of emergency power. Their quick mobility can provide the means to continued service, and continued good public relations.

The economies of Electro-Mobile Power have been demonstrated on many utility applications. Why not ask your Electro-Motive representative to outline briefly ways these trailer units can help improve service and lower costs for your system?

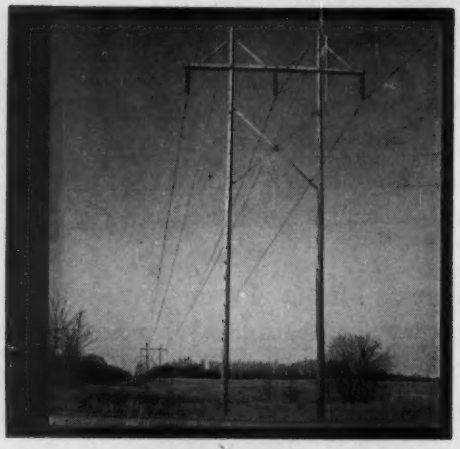
1000 kw units for use on sidings or placed on piers for semi-permanent use.

500 kw units offer excellent mobility for many temporary applications.

LIVE BETTER ELECTRICALLY

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS
LA GRANGE, ILLINOIS
Sales offices in Chicago, New York, St. Louis, San Francisco
In Canada: General Motors Diesel Limited, London, Ontario

GALVANIZED STEEL STRAND

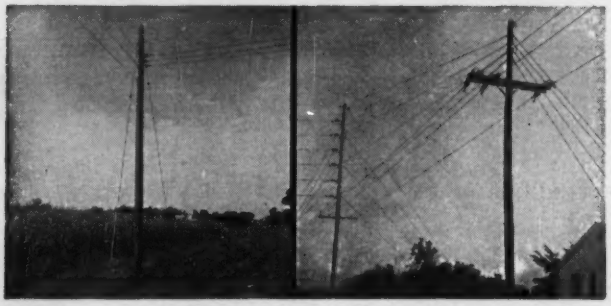


YOUR ASSURANCE OF HIGH QUALITY, LONG LIFE AND LOW COST

Close laboratory control over each step in manufacture has established Crapo Galvanized Steel Strand as a product of highest quality and dependability. You benefit through longer service life and lower ultimate costs.

Heavy, uniform, tightly-bonded coatings of commercially pure zinc, applied by the famous Crapo methods, withstand the punishment of construction, provide maximum resistance to corrosion and contribute to over-all economies.

For OVERHEAD GROUND WIRE . . .
CRAPO Weldless Galvanized Steel Strand



The most practical and economical strand for shielding transmission lines against lightning. Maximum strength and high fatigue endurance, inherent in Crapo Weldless Strand, provide that extra safety factor so important in overhead ground or static wire.

For GUYS and MESSENGER . . .
Crapo Galvanized Steel Strand. Made to highest standard specifications . . . a size and breaking strength to meet all practical needs.

Contact your jobber or write for descriptive folder.

INDIANA STEEL & WIRE CO., INC.
Muncie, Indiana

Light Trenching Machine . . .

. . . digs 3, 4.5, or 6-in. trench to depth of 2 ft. Only 34-in. wide, it will go through standard width gate for work inside fenced yards. It is completely mobile under its own power and can be easily handled by one man. Digging speed is 4 fpm. Designated the Model C Ditch Witch, it is powered by a 7.5-hp air-cooled gasoline engine.

Charles Machine Works, Inc, 637 Birch St, Perry, Okla.

Dielectric Test Set . . .

. . . measures dc at voltages up to 100 kv. Polarized primary prevents set from rising above ground potential. High voltage reset button keeps high voltage from being accidently energized.

Known as Model 2, the set may be used in development, production, or maintenance for non-destructive testing of dc dielectric strength, and detection of defects. Bulletin 22-9 has further data.

James G. Biddle Co, 1316 Arch St, Philadelphia 7, Pa.

Aluminum Alloy Bus Bar . . .

. . . has 60% I.A.C.S. minimum electrical conductivity. Designated No. 2 EC-T64, it has 15,000-psi tensile strength, 8,000-psi yield strength. Bending properties are excellent.

The material is same price as its predecessor which had 59% minimum conductivity.

Aluminum Corp of America, Alcoa Bldg, Pittsburgh, Pa.

(*More New Equipment on page* 92)

RT&E Transformers

Weather Protected to Serve Longer

Like the postman, neither rain nor snow, nor hail, nor salt spray can prevent R T & E Transformers from doing their duty. Here's proof that every R T & E unit is completely "WEATHER PROTECTED."

- **FINISH:** Three coats of modified Alkyd paint for all season protection.
- **DESIGN:** Domed cover for immediate water run-off.
- **TANK:** Arc-welded seams and absence of lip on tank bottom mean no moisture collecting cracks and crevices.
- **BUSHINGS:** HV bushings internally clamped — no external clamps and bolts to corrode.

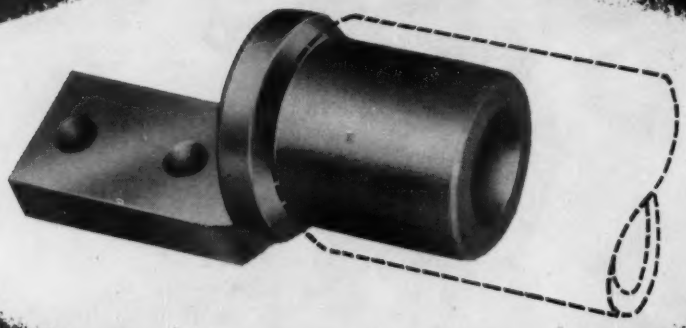
Plus stainless steel cover band to eliminate corrosion on accidentally scratched areas . . . stainless steel threaded mounting pads . . . all unpainted fittings either galvanized or electro-tinned.

R T & E "Weather-Protected" Transformers last longer, require less maintenance, serve better all year 'round.

Equipment to help provide power for America.

RT&E
CORPORATION
WAUKESHA, WISCONSIN

ROYAL'S new
ALUMINUM
WELDING FITTINGS



PROVIDE
INTERNAL SUPPORT

- Prevent loss of strength due to annealing
- Prevent moisture penetration
- Minimize corona

FREE HANDBOOK

Now, for the first time, a complete handbook of aluminum welding fittings is available as a separately bound manual, or as part of Royal's new 150 page Aluminum Connector Catalog No. 1. A copy of this new handbook may be had by requesting it on your company letterhead.

ROYAL

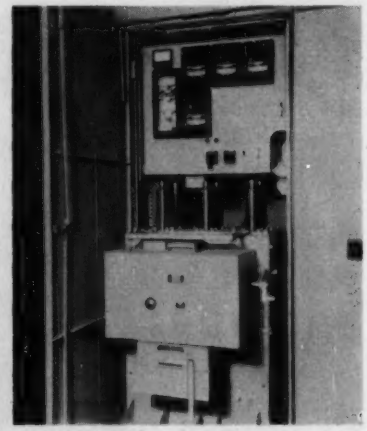
A part of the arsenal of AMERICAN POWER PRODUCTION

ROYAL ELECTRIC MANUFACTURING CO., INC.
1122 EAST 87TH STREET • CHICAGO 19, ILLINOIS
Designers and Manufacturers of Power Switching Equipment and Special Electrical Devices

Motors . . .

. . . range from ⅓ to 800 hp. Full line includes capacitor-start or polyphase-induction fractionals, weatherproofed single-phase integrals from 1 to 5 hp with sealed starting switch, and polyphase drip-proof integrals up to 800 hp in NEMA frame sizes. Single-phase models use 115 and 230 v. Polyphase models use 208, 220, 440, and 550 v.

A. O. Smith Corp, Electric Motor Div, Tipp City, Ohio



Outdoor Switchgear . . .

. . . with breakers and control panel on same side of unit is available in ranges from 2.4 to 13.8 kv, 50 to 1,000 Mva. Access to rear of unit is no longer necessary, foundation pad size and station space requirements are reduced. Testing and maintenance are simplified.

Control panel is mounted on inside "dutch door" that swings out for easy access to bus connections. Breakers may be removed without disturbing panel. Unit is metal-clad, with preassembled, protected aisle as optional equipment.

General Electric Co, Schenectady 5, N. Y.

Induction Heater . . .

. . . produces 180-cps, 1-phase output from 60-cps, 3-phase input with efficiency of about 85%. Called the Frequency Transformer, it con-

(*Continued on page* 94)

NOW...Sangamo Presents...

A NEW TWO-STATOR FOUR-WIRE DELTA METER

for new advantages in 240v measurement

GREATER RANGE OF APPLICATION—Extended range, in both directions, lets the Sangamo P2SΔ Meter start at ¼% of rated load—yet operate continuously at 666⅔% of rating with only 50°C maximum temperature rise. You can use this meter for small loads and large ones.

EASIER ADJUSTMENT AND MAINTENANCE—All adjustments are easy to reach and make—direction of effect is indicated—backlash is eliminated. Low friction register is simple in design, provides automatic mesh adjustment. Potential coil can be easily replaced without any disassembly of other components.

HIGHER INSULATION LEVEL—The individual windings of the current coil are encapsulated in chlorinated polyether insulation of high dielectric strength. Voltage breakdown is in excess of 10,000 volts RMS—the equivalent of a 15 KV surge.

SAVINGS IN HEIGHT AND COVER REPLACEMENT
The Sangamo P2SΔ Meter has been substantially reduced in height. The cover is the same as that used on all singlephase metal base socket meters manufactured since 1936.

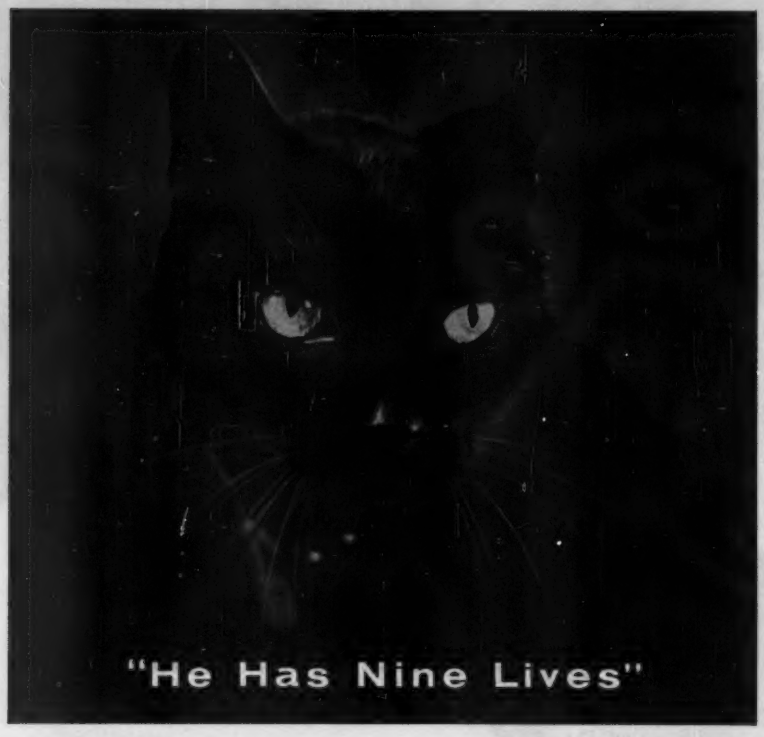
PROVEN ECONOMY THROUGH SLOW SPEED
Sangamo *slow speed*—proved so well on the singlephase J2 Sangamo Meter—gives even greater benefits in two-stator meters. Reduced series damping and fewer revolutions just naturally mean greater accuracy and better performance.

THE COMPLETE LINE OF LIFETIME GUARANTEED SANGAMO TYPE P METERS WILL HANDLE ALL POLYPHASE MEASUREMENT

SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

JH57-9



..but for long collector life

THE AEROTEC NEW 5 RWS

Aerotec's latest development in the field of erosion resistant dust collector tubes is unique.

Aerotec engineers proved, by accelerated tests under erosive conditions many times greater than normally encountered, that of all metals tested, white cast iron assures maximum resistance to abrasion.

These tests are substantiated by actual installations. They now establish the Aerotec 5 RWS collector with white iron tubes as the ultimate in long life and sustained high efficiency in the field of mechanical collection.

If your dust collection problem requires top mechanical efficiency, discover the assurance of highest performance and long life possible only with an Aerotec 5 RWS. Call or write our Project Engineers today. They are ready to help you solve your dust control problem.

Project Engineers THE THERMIX CORPORATION Greenwich, Conn.
(Offices in 38 principal cities)
Canadian Affiliates: T. C. CHOWN, LTD., 164 Metcalfe Ave., Westmount, Montreal 6, Que.
Manufacturers
THE AEROTEC CORPORATION
Greenwich, Conn.

Induction Heater

(*Continued from page* 92)

sists of a special transformer and standard capacitors, has no moving parts, tubes, or spark gaps.

The unit has greater penetration than higher frequencies. Infinitely variable automatic or manual output control operates over wide range of load conditions. Sizes range from 50 to 300 kw output. Units may also be used for testing 60-cps transformers or as fluorescent lighting power supply.

Ther-monic Induction Heating Corp, 181 Wythe Ave, Brooklyn 11, N. Y.

Pole-Mounted Sign . . .

. . . for utility advertising is quickly detachable, can be easily removed when linemen are working on poles. Made of tough, phenolic resin plywood, line includes sizes from 4x3 ft to 8x4 ft. They may be obtained either blank or custom-painted to customer's specifications.

Arco Mfg Co, Grand Forks, N. D.

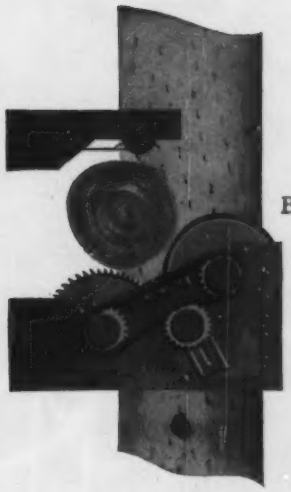
Capacitor Equipment . . .

. . . in waterproof housing is available in ratings from 60 to 180 kvar for 230 v and 80 to 240 kvar for 460 and 575 v, 60 cps. The 230-v equipment uses 15-kvar units; the higher ratings, 20-kvar units. All capacitors are individually fused. Line is designated type LSO.

Removable plate at base of case can be drilled for incoming line connections. Grounded terminal on inside of housing can be connected to system ground. Clamp-type line terminal connectors require only a wrench for connecting cables.

General Electric Co, Schenectady 5, N. Y.

"No, Babe, them ain't woodpecker holes!" Paul Bunyan and his Blue Ox were admiring a BAXCO Douglas Fir pole just off the shaving-incising machine. Paul carefully lifted a shed off its foundations to reveal the operation. "See that there wheel with all the teeth, Babe? Well, she's another invention of them Baxter folks—called an incisor✻ While the pole gits shaved it also gits nicked its entire length by these teeth so as the presarvatives can git a good holt in the wood." Paul giggled. "Works kinda like a bum barber, don't it?"



BAXCO® DOUGLAS FIR POLES / FULL LENGTH MACHINE INCISED
(pressure treated)

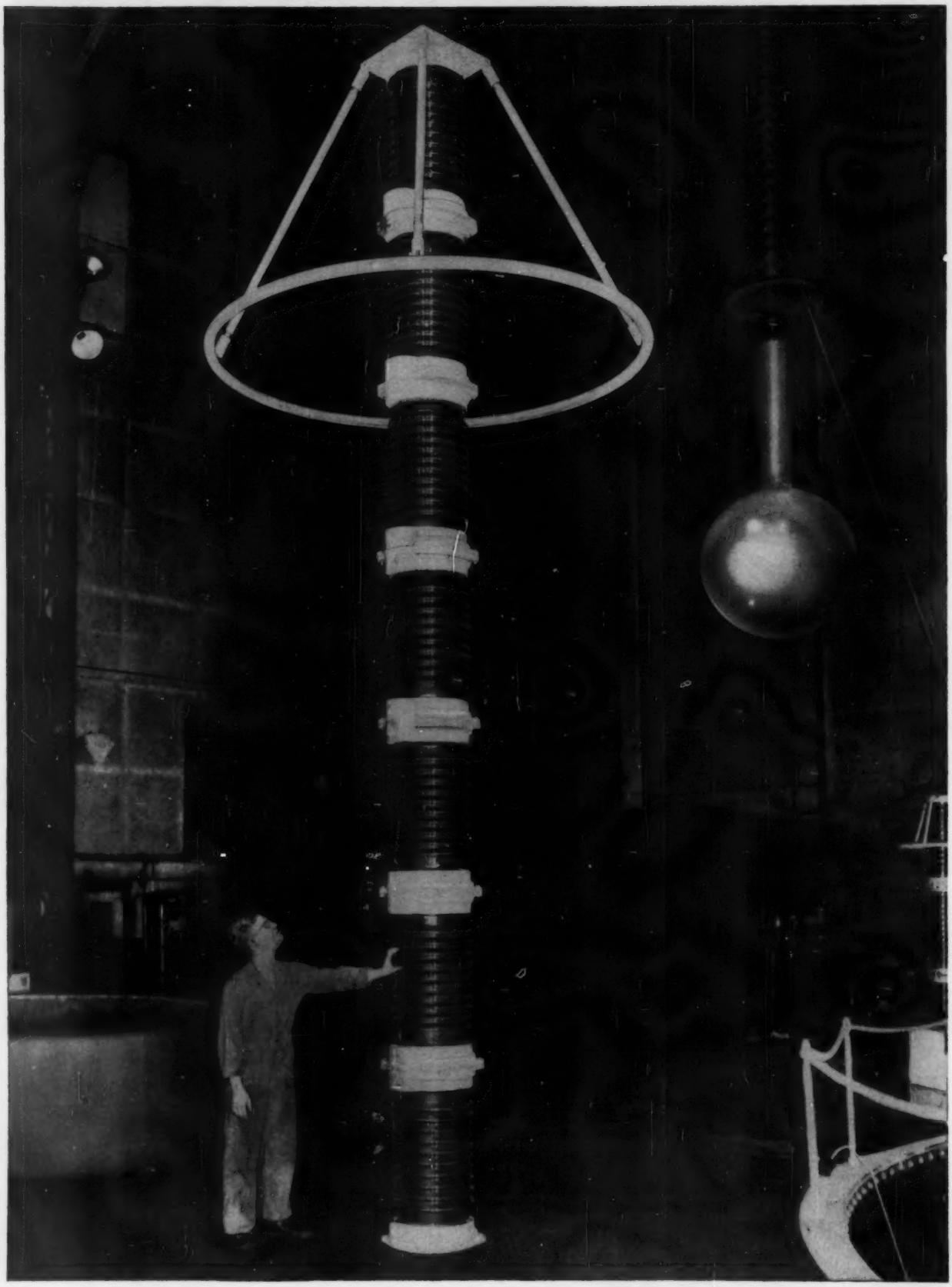
✻Yes, Paul, if you're a fir pole it DOES pay to "git nicked" while getting shaved. Because those "nicks," or small incisions made by the teeth of the incisor over the full length of the shaved wood surface assure a more uniform distribution of the preservative forced deep into the wood by pressure treatment. End result: longer pole life.

Furthermore, this incising operation (U.S. patent No. 2,781,802) tends to minimize checking. So for longer lasting, better looking poles specify BAXCO Douglas Fir Poles, always incised, always machine shaved, and always pressure treated.

Pressure treatments available: Creosote, Chemonite, Pentachlorophenol, in accordance with Federal and AWPA specifications.

© J. H. Baxter & Co. 1957

J. H. BAXTER & CO. *120 Montgomery Street, San Francisco 4, California*

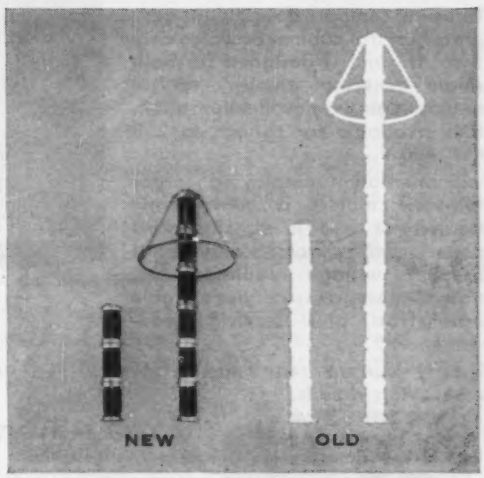


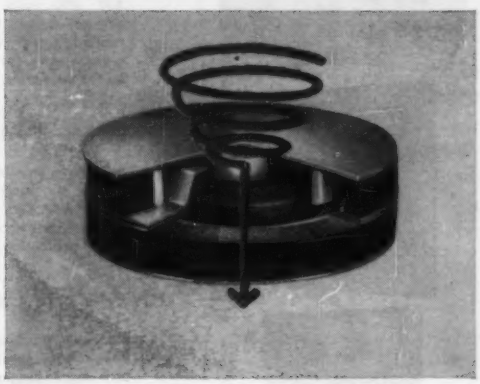
Tomorrow's lightning arresters TODAY!
. . . at no premium investment!

LOW IN HEIGHT
HIGH IN PERFORMANCE

Critical space allowances and greatly increased operations due to switching surges are writing new requirements for station lightning arresters.

The situation isn't likely to improve — but Westinghouse arresters **have** — to a greater degree than present or foreseeable future requirements call for.





HERE ARE TWO BASIC IMPROVEMENTS:

Physically parallelled elements

While still in series electrically, allow height reductions up to 45%. Self-supporting . . . these arresters have up to 300,000 pound-inch cantilever strength. Installation is far simpler.

New Mobilarc Gaps

The application of ceramic permanent magnets spins the arc over the electrode, thus eliminating pitting or other damage to electrodes. No change in gap characteristics — even after as many as 1,200 test operations.

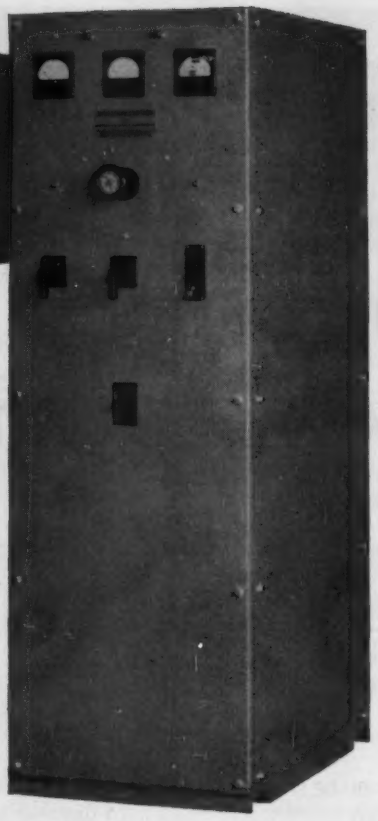
These features are in addition to such long-standing Westinghouse advantages as pre-ionized gap-assemblies, pressure relief diaphrams, non-corrosive aluminum-alloy end-castings and solder-sealing to eliminate the moisture problem. It's worth your time — and your money — in your planning for the future, to talk to your Westinghouse sales representative.

J-60913

YOU CAN BE SURE...IF IT'S

Westinghouse

New CAB
New ECONOMY
New VERSATILITY

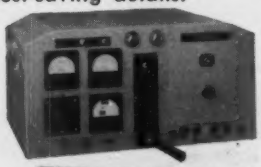


DIESEL GENERATOR *Control*

This new compact floor mount generator control cabinet occupies only 5 sq. ft., and is designed for both single generator standby service and multiple set parallel operation. It is available for ratings to 250 KW, 480 V.

Instrumentation employing large-full-view meters is conveniently located at eye level. Standard parts including molded case circuit breaker, voltage regulator, and transformers assure dependable operation plus servicing convenience.

Specify current requirements for cost-saving details.



TOP MOUNT

Engine-mounted controls for requirements to 150 KW, 480 volts . . . Single and dual voltage service, A.C. or D.C. Also wall-mounted controls to 75 KW, 220/480 V. Standardized components and circuitry for dependable operation and service convenience.

TRANS-O-MATIC

Automatic switch transfers to emergency on failure of normal source. Mechanically linked circuit breakers assure positive transfer . . . with no neutral position possible. Complete relay protection.

ENGINE START CABINET

Single and 5-shot interrupted crank controls for dependable engine starting. Complete cut-out and alarm protection for over-crank, over-speed, low-oil, and water-temperature. Four-position operation "automatic", "test", "manual" and "off"

Request Bulletins For Detail

LAKE SHORE *Electric* **CORPORATION**
207 WILLIS STREET
BEDFORD, OHIO

Books

EHV in Germany

380 Kv Planning. **Published by Deutche Verbundgesellschaft, Heiledberg, Germany. 111 pages, illustrated**

This book presents in detail the planning of a 380-kv high voltage transmission network for the German Federal Republic. It is published by the German Association for Joint Operation whose main duties are to promote the development of German joint economy and to strengthen the collaboration and cooperation among joint enterprises.

The main emphasis is on planning for such an elaborate undertaking but enough of the design details are given to allow transmission engineers an insight into the latest thinking of German engineers on extra high voltage transmission. Such things as bundled conductors (4 cables per phase), tower design, switchyard layout, and insulator assemblies are discussed in the book. A brief summary of findings made at an experimental installation are included.

Fundamentals of Heat

Heat and Thermodynamics, Fourth Edition. **By Mark W. Zemansky. Published by McGraw-Hill Book Co, Inc, 330 W 42nd St, New York 36, N. Y. 484 pages, illustrated. Price $7.50.**

This book is offered as an intermediate textbook for students of physics, chemistry, and engineering. It is written by a physics professor and consequently it is presented from a.. exacting mathematical viewpoint.

New material in this fourth edition includes: the Gianque temperatur scale, Onsager method of treating irreversible coupled flows, dielectric phenomena, piezoelectric effect, second order phase transitions, and low temperature physics.

The text is divided between theory and application. The first ten chapters deal with fundamentals. And the last nine chapters deal with engineering, physical, and chemical applications.

The ABC's of Transistors

Transistor Circuit and Applications. **Edited by J. M. Carroll. Published by McGraw-Hill Book Co, Inc, 330 W 42nd St, New York 36, N. Y. 285 pages, illustrated. Price $7.50**

This book gives a complete picture of transistor structures, techniques, circuits and equipment. It is based on articles that have appeared in *Electronics* magazine. Chapter headings cover principles, design, oscillators, pulse circuits and applications—such as, computers, communications, and broadcasting.

IMPORTANT NEWS TO UTILITY EXECUTIVES

A significant new appliance that will help level the peaks of your residential loads.

REVOLUTIONARY FEDDERS HEAT PUMP AIR CONDITIONERS

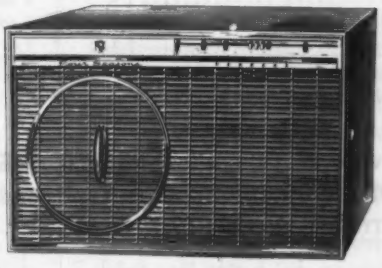
Now Being Produced in Volume and Merchandised Coast-to-Coast

Dramatic new engineering achievements by Fedders, can help meet the problems and opportunities of the electric power industry created by the rapid growth of summer air conditioning—a *July-August peak that is bound to climb to far higher levels in the future.*

A complete line of heating and cooling window air conditioners (central units, too) is ready now to boost residential consumption on a stable year 'round basis, everywhere in the United States. Thousands of homes will enjoy *extra months of winter comfort this year . . . for the price of summer air conditioning alone.*

These engineering advances make this possible:

1. BTU/watt ratios now make electricity competitive with other heating fuels in many areas.
2. The "frost-up" problem which restricted heat pump air conditioners to warmer climates is finally solved by Fedders' WeatheRobot Automatic Defrost Cycle.
3. "Four Seasons" models for operation in any weather, anywhere in the United States, provide all-weather economy by the unique combination of heat pump action and resistance heating—down to zero degrees and below.
4. Fedders heat pump models up to 2 HP capacity are now available for every room size and every voltage requirement, 230-, 208-, and even 115-volts.



POWER FACTORS UP TO 99.9%

Now – 12 ampere 1½ HP and 7½ ampere 1-HP heat pumps operate on 115-volts. Exclusive Automatic Defrost Cycle permits operation in below freezing weather. Other models for 230 and 208-volt operation in 1-HP, 1½ HP and 2 HP capacity.

ALREADY—in these current winter months—the new Fedders Heat Pump models are being produced in volume and actively merchandised by thousands of dealers.

Eleven million families have read about them in Reader's Digest. Tens of millions more will learn about them in their local newspapers.

To help *your* company profit from this new load-building, load-molding appliance, mail coupon today for specification sheets, engineering data, merchandising plans and materials.

FREE "Newest way to Live Better...Electrically"

Full-color bill enclosure describes the "Newest Way to LIVE BETTER...*Electrically*" without any brand identification or specific product features.

FEDDERS-QUIGAN CORP.
Box Number EW-18
Maspath 78, New York

Please send me full information about the New Fedders Heat Pump Air Conditioners plus a sample copy of the consumer bill enclosure entitled "Newest Way to Live Better Electrically."

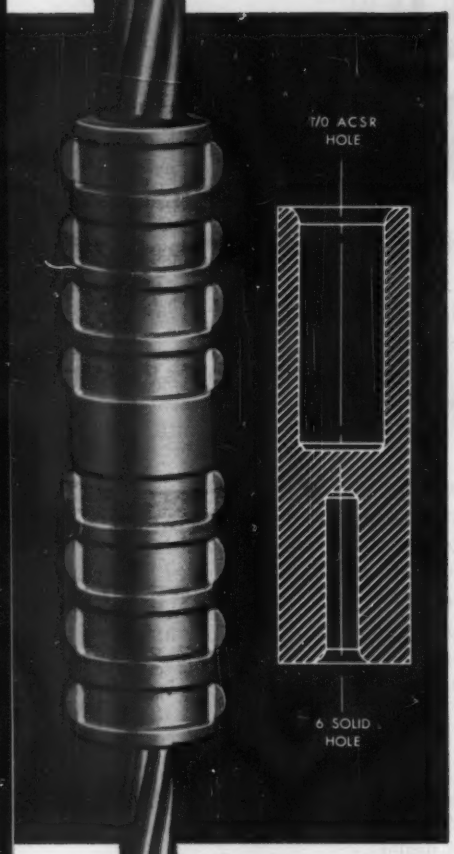
NAME_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE___ STATE_____

You get HIGHER CONDUCTIVITY with BLACKBURN SERVICE ENTRANCE SLEEVES



because Blackburn... and Blackburn alone... provides GREATER CONTACT AREA where needed

Hole Depth Increases With Size of Conductor... thereby providing more contact area for the conductors being connected.

COLOR CODE	WIRE SIZE ACSR	WIRE SIZE AWG	HOLE DEPTH IN INCHES
Brown	–	8 sol — 10 str	.820
Green	–	6 sol — 8 str	.840
Blue	6	4 sol — 6 str	.860
Orange	4	2 sol — 4 str	.925
Red	2	1 sol — 2 str	1.010
Yellow	1/o	1/o str	1.185

The center stop in a Blackburn Sleeve is a solid barrier that assures proper distribution of the inhibitor around the conductors.

FIRST! Printed (not indented) permanent COLOR CODING is *easier to read*—makes size identification positive and quick.

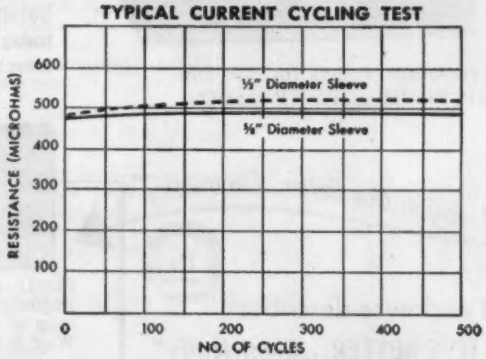
FIRST! Aluminum Sensitized Tape seals the Blackburn Sleeve's ends. Easy to puncture... and, if a particle of the seal is pushed into the chamber, it is conductive.

FIRST! Each Blackburn Sleeve contains the superior Blackburn inhibitor, Contax, *in measured amount*. Won't squirt out on glove or in face.

LIVE BETTER ELECTRICALLY

Conductivity of Connection PROVED GREATER Than Equivalent Length of The Conductors Being Connected.

TYPICAL CURRENT CYCLING TEST



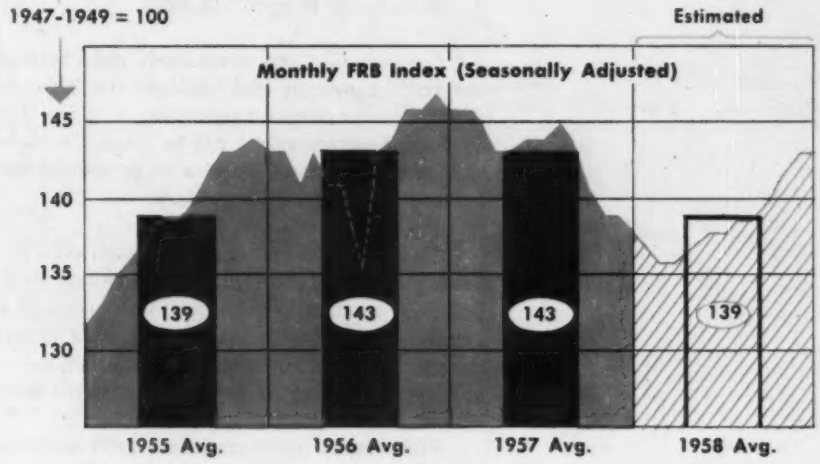
A series of typical current cycling tests were conducted with both ½" x ⅜" diameter BLACKBURN Sleeves. Note the lower resistance of Blackburn Sleeves as compared to the equivalent length of cable without any sleeve.

Test Conditions

Wire: 2 ACSR to 4 stranded copper
Current: 190 Amperes
Cycle: 2 Hrs. "On" 1 Hr. "Off"
Length of Connection: 24 inches
Curves represent an average of five tests
Resistance of equivalent length of wire: 527 Microhms

JASPER BLACKBURN CORPORATION, 1525 Woodson Rd., St. Louis 14, Mo. • WYdown 3-9430

The Electrical Business Outlook



'58 Production Takes a Mild Dip

1958 starts off with a mild downswing in business well underway. Actually most business forecasters didn't expect the boom to fizzle out quite that quickly. Usually it takes several months or longer for the economy to level off and turn downwards—even for a temporary dip.

Three main factors have been working to drag down the economy over the past few months. (1) sharp cuts in defense (2) the gradual decline in capital spending (3) inventory liquidation, particularly on the manufacturing level. As we've pointed out before, these were the expected rough spots in the '58 picture. They just came a little ahead of schedule.

Industrial production will continue to drop off a bit in the next few months, reach a low in early summer, and then pick up gradually in the second half. For 1958 as a whole, output will average about 139 on the Federal Reserve Board index—off only a few points from the 1957 record. Of course, 1958 is a wage bargaining year so there's the possibility of strikes in some industries which could accentuate the dip in production. But that just means a bigger rebound later as depleted inventories are rebuilt. Overall the decline should be less than 3%, which is mild no matter how you look at it.

There's a bright spot as far as utilities are concerned. The sharpest production cuts are coming in machine tools, aircraft, mining, and railroad equipment—all relatively light users of electric power. Except for moderate declines in paper and primary metals, the production outlook for the big users of power is firm. Here's how the McGraw-Hill Dept. of Economics charts the trend for the five industries—chemicals, paper, food, textiles, and primary metals (as a group, these five industries account for over 60% of industrial kwhr):

•In 1957 chemical output ran 4% above the 1956 record. For 1958 chemical manufacturers foresee a smaller gain in output, about 1 or 2%. The industries

which are being counted on to give this added boost in demand are rubber, paint, agriculture, plastics, and textiles.

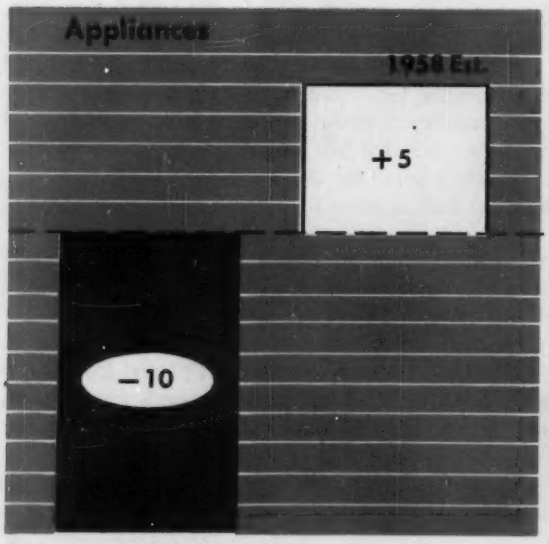
• Output of paper and allied products generally moves along with overall industrial production—which means a 3% dip this year. But inventories of paper products are in much better shape than a year ago, so there's no danger of drastic cutbacks in operating rates.

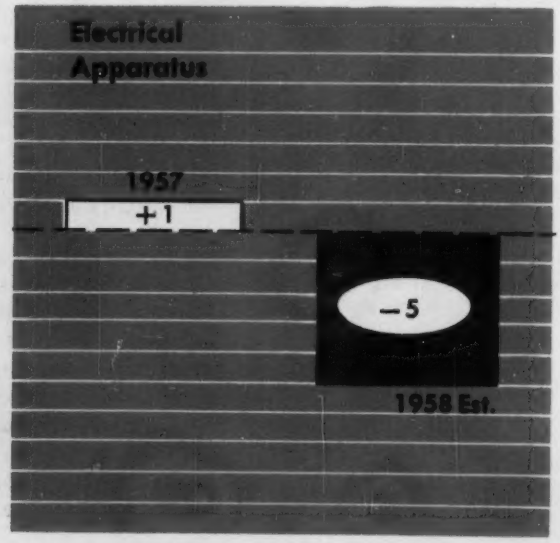
• Production of processed foods and beverages didn't show much of a gain last year. Unusually bad weather—droughts, floods, tornadoes—added up to slightly smaller crops for processing in 1957. If the weather gets back to normal, food and beverage output will be about 2% higher. With a booming population and the steady trend towards a bigger market for processed foods, any lull such as last year's is strictly temporary.

• Overall textile mill output dropped off 4% in 1957—with synthetic fibers holding even, and cotton, wool, and knitted goods off from 5-10%. All through last year, production schedules were trimmed back in an attempt to balance inventories. But for '58 chances look good for textiles to break out of their 3-year slump. Consumer soft goods are expected to be relatively insensitive to the '58 adjustments and textile output should move up a moderate 2%.

• For primary metal producers 1958 looms up as the first year since Korea that virtually all metals will be in more than adequate supply. Steel makers anticipate a marked sag in demand, since the capital goods boom is over and autos don't look like they'll make up the difference. On the average the new '58 steel capacity will be running about 79%, which means that about 109 million tons of steel will be turned out—off 4% from the '57 level. Non-ferrous metals will also show a drop of about 3%, more or less in line with the overall dip in industrial production. Lead, zinc, and copper still suffer from an acute hangover of overproduction and sagging prices. And it looks like the real "bounce back" year will have to wait 'til 1959.

For electrical manufacturing the outlook shapes up like this: Output of heavy electrical apparatus won't quite match the '57 record high. New orders are down and backlogs have dropped off considerably. Production will be down about 5% for the year. But home appliances should see a 5% gain. This ties in closely with a rebound in housing starts to 1.04 million.





The Electrical Manufacturers Outlook

Business Statistics . . .

		Latest Month	Preceding Month	Year Ago	Annual Change %
Indexes: 1947–49 = 100					
FRB Industrial Production	Nov.	141	145	147	−4.1
ENR Construction Cost	Dec.	154.7	154.6	147.6	4.8
BLS Cost-of-living	Oct.	121.1	121.1	117.7	2.9
New Orders for Machinery (1950 = 100)	Oct.	119	141	139	−14.4
NEMA Sales					
Insulation materials	Oct.	133	135	163	−18.4
Electric appliances		88	97	94	−6.4
Wholesale prices	Oct.				
Motors and generators		143.0	143.3	136.9	4.5
Transformers and regulators		150.8	150.8	144.8	4.1
Switchgear and fuses		170.9	170.6	161.9	5.6
GNP—annual rate—$ billion	3rd Qtr.	439.0	434.3	416.7	5.4

NEMA Lines up with Optimists

Over $21 billion worth of business is the sum of electrical manufacturers' expectations for 1958, according to the National Electrical Manufacturers Association. Anticipated gains in most branches of the industry outweigh some losses expected in others. Here's NEMA's breakdown:

- **Generation, transmission, and distribution equipment** manufacturers expect shipments to hit a record $2.49 billion this year. That would be a 2% rise over 1957's total of $2.44 billion.

- **Insulated wire and cable** dollar volume is put at $1.508 billion, for a small gain of $100,000 over the 1957 figure. From 1956 to '57 wire and cable shipments dropped off 20%.

- **Illuminating equipment** shipments will be up 6% to $953 million, according to the estimate. This would eclipse the 1957 record of $899 million.

- **Industrial apparatus** is expected to dip to $3.15 billion for a 3% loss. In spite of pessimism late in the year, 1957 set a record with $3.24 billion in shipments.

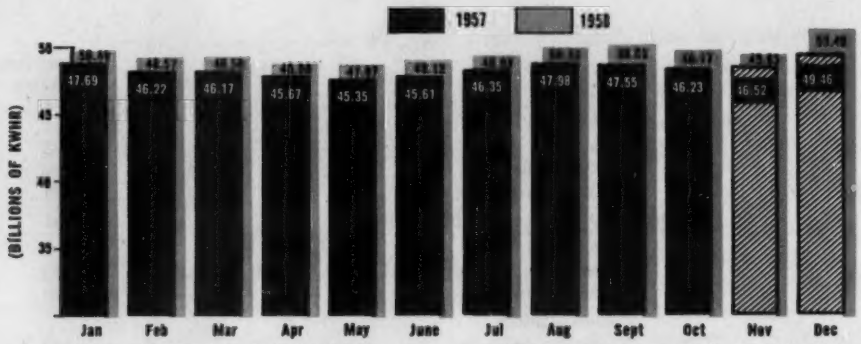
- **Insulating materials** makers see another decline in volume, with 1958 shipments at $344 million. This is down from $347 million last year—a fractional drop.

- **Appliances** are in for a healthy gain, say the manufacturers. They look for $4.45 billion in shipments for '58. This would be a 6% increase over the 1957 figure of $4.2 billion, but would still trail both 1955 and 1956. Electric dishwashers are expected to top '56 sales. Other big gainers: electric ranges and dehumidifiers.

- **Other electrical products, including communication and building equipment,** account for the remaining $8.2 billion worth of shipments. Taken all together, electrical manufacturers expect to add over $200 million worth of business to their 1957 total of $20.88 billion.

The Electric Utility Outlook

Sales Forecast . . .



EW Forecast Nov., Dec. '57, all of 1958

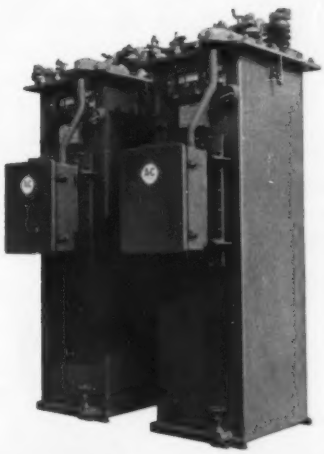
Non-estimated data: Edison Electric Institute

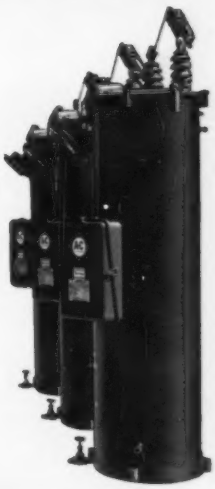
Utility Statistics . . .

		Latest Month	Preceding Month	Year Ago	Annual Change %
Capacity	Sept.	126.24	125.75	118.66	6.4
Peak—Class A Systems (million kw)	June	104.6	97.8	97.2	7.6
Estimated Dec. '57 Peak (million kw)	Sept.	112.8	113.0	114.8	−1.8
Production—billion kwhr	Oct.	53.16	51.57	51.13	4.0
Hydro		10.04	9.28	9.24	8.7
Fuel		43.12	42.29	41.89	2.9
Sales—billion kwhr	Sept.	49.01	49.79	46.18	6.1
Residential		12.86	13.05	11.67	10.2
Commercial		8.59	8.76	7.82	9.8
Industrial		24.76	25.06	23.97	3.3
Other		2.80	2.93	2.71	3.3
Fuel Consumption	Oct.				
Coal—million tons		13.82	12.75	13.54	2.1
Oil—million barrels		6.42	5.64	6.28	2.2
Gas—billion cu ft		111.80	137.60	113.81	−1.8
Net Income Class A & B Co's—$ million	Oct.	101.87	116.13	96.62	5.4
Residential Customers—millions	12 mos.	46.61	46.49	45.39	2.7
Revenue per kwhr	ended	2.57¢	2.57¢	2.61¢	−1.5
Avg kwhr per customer	Sept. 30	3,121	3,104	2,929	6.6
Avg annual bill		$80.21	$79.77	$76.45	4.9
Moody's Averages					
Public Utility Bond Yields	Dec.				
Aaa		3.93	4.22	3.79	3.7
Aa		4.05	4.30	3.84	5.5
A		4.58	4.62	3.91	17.3
Baa		4.81	4.82	4.18	15.1
24 Utility Stocks					
Price	Dec.	$50.30	$48.65	$48.96	2.7
Earnings (latest qtr)	Sept.	3.35	3.31	3.35	....
Dividends (annual rate)	Dec.	2.46	2.45	2.37	3.8
Yield (%)	Dec.	4.89	5.04	4.84	1.0

25 YEARS OF LEADERSHIP

IN 5/8% STEP REGULATION



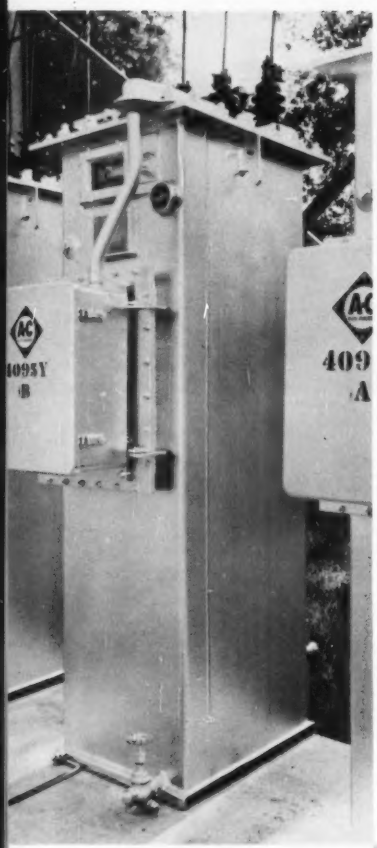


ALLIS-CHALMERS

Originators of 5/8% Step Regulators

Leader

in design...manufacturing proved by 25 years of regulator experience



Check the partial list of "Firsts" for the story of Allis-Chalmers leadership in regulators

Continual research followed the introduction of the first thirty-two 5/8% step regulator by Allis-Chalmers. The result was continuing progress in voltage regulators . . . continuing leadership in features and performance. Some of the "Firsts" are described on the pages that follow.

Together they add up to:

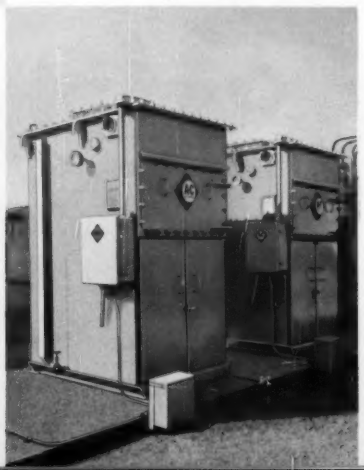
Low-cost, efficient regulation for feeders and substations.

A type and size regulator for every need.

Tried and proved equipment for assured dependability.

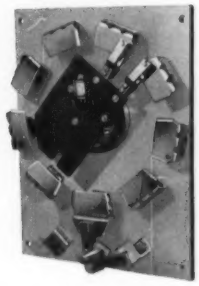
Design simplicity for operating ease.

Unequalled field service.



ship

...development



1933

First 5/8% step regulator for closer regulation

1933

First with *Elkonite* contacts for longer life

1934

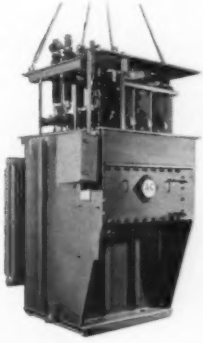
First indoor-outdoor universal regulator for lower costs

1935

First voltage integrating time delay for better regulation

1938

First unit control panel for ease in operation

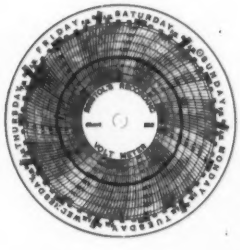


1939

First unit type construction for simplicity of design

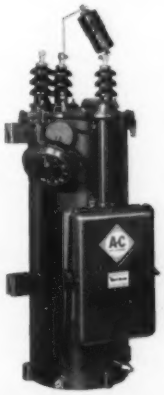
1940

First *Vari-Amp* feature for lower cost of regulation



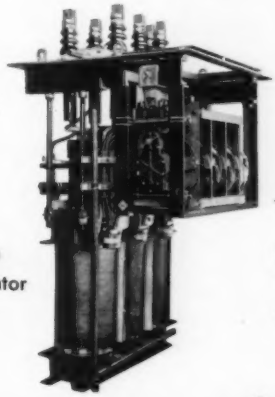
1942

First with 1% accuracy control circuit



1949

First 32-step 5/8% distribution regulator for lower cost regulation

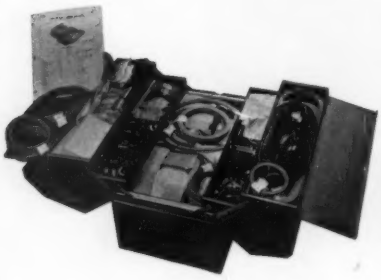


1951

First universal 15-kv regulator for lower costs

ALLIS-CHALMERS

ALLIS-CHALMERS
ALSO LEADS In services

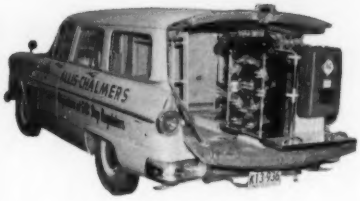


1950

'Round the clock, seven days a week service availability

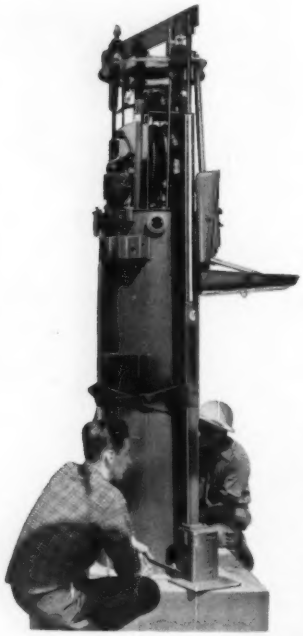
1952

Comprehensive Engineering and Service Manual



1953

Mobile regulator engineering school



1953

Inspection jacks introduced. When used in conjunction with unit type construction, they make field inspection practicable.

1957

Regulator service truck-trailer unit for fast maintenance in field and for teaching utility personnel field service methods.

Take advantage of Allis-Chalmers regulator experience, equipment and service. Call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

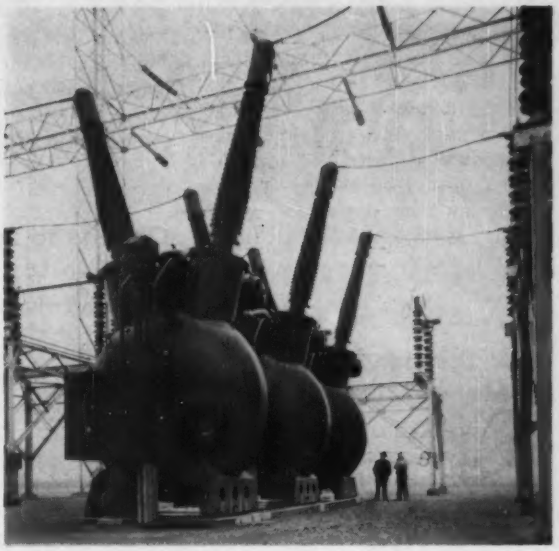
ALLIS-CHALMERS

GE Breaker Interrupts Nearly 14-Million Kva

A 345-kv power circuit breaker manufactured by General Electric Co interrupted nearly 14-million kva imposed in a short-circuit test. This capacity is believed by the company to be the highest developed to date in a field test.

The test was part of an investigation made jointly with American Gas & Electric Corp at the Philip Sporn Station near New Haven, W. Va. More than 100 tests were conducted and included line-dropping and fault-interruption tests. They were conducted primarily to determine the performance of an improved design of the breaker's impulse interrupters.

Illustrated is a Type FGK power circuit breaker for 345-kv service. It is similar to equipment supplied to the Philip Sporn Station and that underwent the tests.



Here's A Peek at Five New Products on the Market

A standard line of sealed dry-type transformers featuring aluminum conductors and buswork are available in 3-phase ratings from 300 through 7,500 kva. This line is a development of General Electric Co. Weight reduction and flexibility of aluminum application are reported significant. Sealed dry-type and several open dry-type transformers are being readied for shipment.

An automatic hydraulic engine throttle booster to prevent engine slow-down when a hydraulic earth borer is used, has been developed by J. H. Holan Corp, Cleveland. The booster goes into action when the auger meets greater resistance. In sequence the carburetor valve is opened farther, thus more power is supplied to maintain uniform speed.

A 400-amp molded-case circuit breaker in a re-designed line is reported to be 5⅞ in. shorter, resulting in space savings up to 30%. Designated NJ-400, it was developed by Federal Pacific Electric Co, Newark, N. J.

Silicon rectifier cells with peak inverse voltage ratings in excess of 1,000 v and a forward current rating of 150 amp have been developed by General Electric Co. These high power rectifier cells reportedly have voltage ratings more than double those presently available. Some applications are industrial shops, and aluminum reduction lines. Prototypes are estimated to be available in March.

Spiracode is a hook-up wire with two or three-colored plastic insulation solid to the conductor. Both vinyl plastics and polyethylene insulation are available. Plastics are applied spirally. Easy circuit identification is provided. Spiracode is made by Alphaduct Wire & Cable Co, New Brunswick, N. J., a division of General Cable Corp.

Nine Standards Published on Electrical Definitions

Nine volumes of American Standard Definitions of Electrical Terms (C42) are available. These are part of a series of new and revised American Standards.

The nine standards cover definitions for rotating machinery; switchgear; industrial control equipment; instruments; meters and meter testing; generations, transmission and distribution; electron devices; electrochemistry and electrometallurgy; electrobiology including electrotherapentics; and mining.

A total of 16 American Standards with about 10,000 terms will make up the complete dictionary when published by the sponsor—American Institute of Electrical Engineers, 33 W. 39th St, New York 18, N. Y.

U. S. Aluminum Production

Primary aluminum production in the United States totalled 135,024 tons in November. The amount is an increase of 1,265 tons over October, but a decrease of about 10,000 tons from November, 1956. Production for the year through November was 1,507,677 tons, down 23,180 tons from the 1956 period.

(*More M&M on page* 110)

Preformed Products Opens New Research Center

A new research and development center will be a $500,000 facility for Preformed Line Products Co, Cleveland, Ohio. This addition will have 20,000 sq ft to house testing equipment as well as the engineering department and executive offices.

The laboratory section is completed and the remainder of the building is on schedule for completion this month.

New Divisions Formed as Manufacturers Expand

New divisions are formed by three electrical equipment manufacturers. **Hill Transformer Co,** San Carlos, Calif., has established an Industrial Products Division for the production of special-duty industrial transformers. Designs will be developed to individual specifications and units built to NEMA and ASA standards. Hill also makes power and distribution transformers to 5,000 kva.

Sargent Electric Corp, Lynbrook, N. Y., has been formed as a division of Pyramid Instrument Corp, to make toggle and trigger switches for small motors and appliances.

Eisler Transformer Co, Inc, has been formed as a wholly owned subsidiary of Eisler Engineering Co, Inc, Newark, N. J., to take over operation of the latter's Transformer Division. Gerald B. Schenkel has been appointed vice president of the new corporation. Manufacturing facilities are established in a new 50,000 sq ft building at 16 North Salem St, Dover, N. J. Transformers up to 1,500 kva, dry and oil-cooled types, will be made there.

Okonite to Supply 138-Kv Cable to Los Angeles

An order for about $1 million of 138-kv, oil-filled cable has been received by Okonite Co from the Department of Water and Power of the City of Los Angeles, Calif.

This cable will be supplied in 85 to 90 lengths of approximately 1,000 ft each for installation between the Scattergood steam plant and local load centers in the Los Angeles metropolitan area. Joints will be made according to the utility's specifications. Shipment to the west coast will be via boat, at the rate of about five lengths per week beginning this month.

The 2,500-Mcm copper conductor will be made in six separate segments and later assembled around a hollow core. The assembly will have 0.625-in.-thick paper insulation and 0.25-in.-thick lead sheath. With a 3.25-in. OD, this unique cable is one of the largest manufactured at Okonite's Paterson, N. J., plant.

Rome Bundles Conduit, Cuts Handling Costs 50%

Shipping EMT and rigid conduit "packaged" in bundles is a successful operation at Rome Cable Corp's conduit plant in Torrance, Calif., according to company spokesmen.

Chief advantage to customers is a reduction in material handling costs of approximately 50%, brought about by the ease and speed of unloading and restacking the conduit. Now a fork truck operator can unload a 20-ton truck in about 40 min. Previously truck and conduit trailer shipments were unloaded by hand. Also shipments in large bundles were broken into small lots.

With the new bundles, receiving department employees can make a faster, more accurate count of incoming stock because each bundle contains a uniform quantity of conduit. There is also less chance of the conduit becoming damaged during shipment because each bundle, unlike individual lengths of conduit, has sufficient weight to keep it securely in place. The bundle's rectangular shape also helps to anchor it while in transit.

Other customer advantages are faster restacking in the warehouse and more efficient utilization of warehouse space. The bundles may be stacked one on top of another to assure maximum storage per square foot of floor area.

Contracts Awarded

• Federal Pacific Electric Co, Scranton, Pa., will furnish station service switchgear, transformers, and bus (copper) duct for the Rocky Reach hydro-electric project. The equipment, costing $166,510, is being purchased by the Chelan County PUD of Wenatchee, Wash.

• Day & Zimmerman Inc, Philadelphia, Pa., was awarded a $503,091 contract by the New York State Power Authority to construct the northern extension of the Barnhart-Adirondack transmission line. The contract covers construction of steel towers and the stringing of 16 miles of 230-kv transmission line conductors and 8 miles of overhead ground wire. The work must be completed by Nov. 1, 1958.

• General Electric Co, Denver, Colo., was awarded a $916,771 contract by U. S. Reclamation Bureau, Denver, to supply two 25,263-kva, vertical shaft generators in the Fremont Canyon outdoor power plant at Alcova, Wyo. Both the GE bid and the second lowest bid, $1,036,823, by Elliott Co, Ridgeway, Pa., were below the engineers' estimate of $1,240,000.

• I-T-E Circuit Breaker Co, Philadelphia, Pa., was awarded a $101,-800 contract by the New York State Power Authority to furnish 15 metal-clad switchgear, a grounding transformer, neutral resistor, and associated equipment for the Barnhart-Plattsburg transmission line.

• John W. Rouse Construction Corp, Gouverneur, N. Y., was awarded a $581,581 contract by the New York State Power Authority to construct the Adirondack Substation near Belfort, Lewis County, N. Y. Contract covers construction of a 230-kv substation complete with control building, fencing, landscaping, and access road, and about 0.5 mile of structural steel 230-kv transmission lines.

(*More M&M on page* 112)

The Microwave Radio System *that Grows... as you Grow!*

RCA Microwave Radio Systems are designed with future needs in mind. They do not face obsolescence because of users' growth. High channel capacity permits orderly growth up to a total of 120 channels for voice, data transmission, supervisory control and other purposes.

RCA was one of the earliest pioneers in the development of microwave for commercial communications. Today, RCA Microwave Systems provide users throughout the world with many important features . . . operation in the most advantageous frequency bands, simplified installation and minimum maintenance cost.

Serving their users with dependability and precision, RCA Microwave Systems are now operated by utilities, gas and petroleum pipelines, cross country turnpikes, and government agencies.

More than a million channel miles of RCA Microwave Systems in service . . . performance proved throughout the world.

RCA Microwave specialists will be glad to answer any questions and help plan your installation. Mail coupon for further particulars.

SPECIAL NOTE TO RCA CUSTOMERS:

Ask about the RCA "Package Expansion Plan" which confirms your wise choice of RCA CW-20 or MM-26 Microwave for your communications system. A minor field modification will bring your system up to 48, 72 or even 96 channel capacity, depending on your revised requirements.

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☐ Tell me more about RCA "Package Expansion Plan."
We have RCA_____Microwave.

☐ Send latest literature on RCA Microwave Radio for use in _____

NAME_____TITLE_____
(PLEASE PRINT)

COMPANY_____

ADDRESS_____

CITY_____ZONE___COUNTY_____STATE_____

☐ Have representative contact me.

13 Koppers Precipitators to be Installed in Early '58

Erection will begin early in 1958 on 13 electrostatic precipitators at three industrial plants. Fabrication of the units is underway by Koppers Co, Inc, Metal Products Division, Baltimore. Each precipitator will be energized by a vacuum-tube power unit.

At U. S. Steel Co, Gary (Ind.) Works, eight precipitators will be added to bring the total to 19 Koppers units. New precipitators will be used to clean blast furnace gas. The installation will consist of four pairs of horizontal-flow, irrigated-plate type units. When handling 101,000 cfm of saturated gas at 85F through each pair of precipitators, the cleaning efficiency will be 95%.

New Jersey Zinc Co, Palmerton, Pa., will get three precipitators for a flash-type zinc-roasting operation. The three units will clean a total gas volume of 39,200 cfm at a design cleaning efficiency of 98% at 500F. Each unit will have two precipitating fields. A fourth will be installed at Gloucester City, N. J., as an acid-mist precipitator in a calcining operation. It is designed to clean 24,000 cfm of gas at 140F and 96.2% efficiency.

McLouth Steel Co, Trenton, Mich. will install a double-chamber, single-field electrostatic precipitator, together with a mechanical collector. It will clean gas emanating from an iron ore sintering machine. The combination is designed to give approximately 98% efficiency when handling 200,000 cfm gas at 350 F.

Exide Batteries Operate at Eight Nuclear Projects

Storage batteries are pioneering again in the utility industry, this time in the development of nuclear power. A total of more than 10,000 Exide cells are in use in eight nuclear projects, according to Electric Storage Battery Co, Philadelphia, Pa.

Exide-Manchex batteries play a role at the Shippingport plant of Duquesne Light Co (EW, Dec. 23, 1957, p 11), the first full-scale commercial nuclear power development in the United States.

Other atomic energy projects in which Exide batteries have been operating are: Argonne National Laboratory (Ill.); Brookhaven National Laboratories (N. Y.); Fort Belvoir Package Power Reactor (Va.); Hanford Atomic Products Operation (Wash.); Savannah River Project (S. C.); U. S. Atomic Energy Commission Projects at Oak Ridge, Tenn.; Paducah, Ky.; and Rocky Flats, Colo.

Northwest Firm to Design Arctic Steam Electric Plant

North Pacific Consultants, a consulting firm of Portland, Ore., and Anchorage, Alaska, will prepare preliminary designs for a $6-million steam-electric plant in Alaska. It will be built for the Golden Valley Electric Association, Inc., of Fairbanks.

The plant is to have an installed capacity ranging from 15,000 to 30,000 kw. Its output will be transmitted by a high-voltage line to the Association's system. The plant is to be located in the Nenana coal field area about 100 miles southwest of Fairbanks.

Ivan Bloch, partner of North Pacific Consultants, advised that G. E. Wieland, a steam-plant consultant of Seattle, has joined the firm's board of consultants. Other partners include Norman W. Haner, consulting engineer of Portland, and Robert W. Retherford of Anchorage, Alaska.

Taylor-Winfield Acquires

Taylor-Winfield Corp, Warren, Ohio, electric welder manufacturer, has purchased the lines of metal-forming and work-handling machinery formerly built by Struthers-Wells Corp, Titusville, Pa.

INDUSTRY FILMS

THE MAGIC CYLINDER: 16 mm, color and sound, no rental charge. Demonstrates advantages and disadvantages of various types of lightning protector equipment. Hubbard & Co, 6301 Butler St, Pittsburgh 19, Pa.

RIGHT OF WAY BRUSH CONTROL: 16 mm film, sound and color, 17 min, no rental charge. Describes the botanical system of brush control, and emphasizes public relations and conservation values. R/W Maintenance Service, 980 Ellicott St, Buffalo 9, N. Y.

QUALITY UNLIMITED: 16 mm, color and sound motion picture, 30 min, no rental charge. Stays with the production of wire rope from basic steel to testing of finished product. Colorado Fuel & Iron Corp, 575 Madison Ave, New York 22, N. Y.

ALL HOLES BARRED: 16 mm, color and sound motion picture, 20 min, no rental charge. Presents correct applications of Scotchrap vinyl pipe insulating tape for corrosion prevention. Minnesota Mining & Mfg Co, 900 Fauquier Street St. Paul 6, Minn.

COLOR MAGIC: 16 mm film, color and sound, 22 min, no rental charge. Illustrates some principles involved in using color in industry, in design, and in the home; a companion movie to "This Is Color" treating the physics of color. Interchemical Corp, 67 West 44th St, New York 36, N. Y.

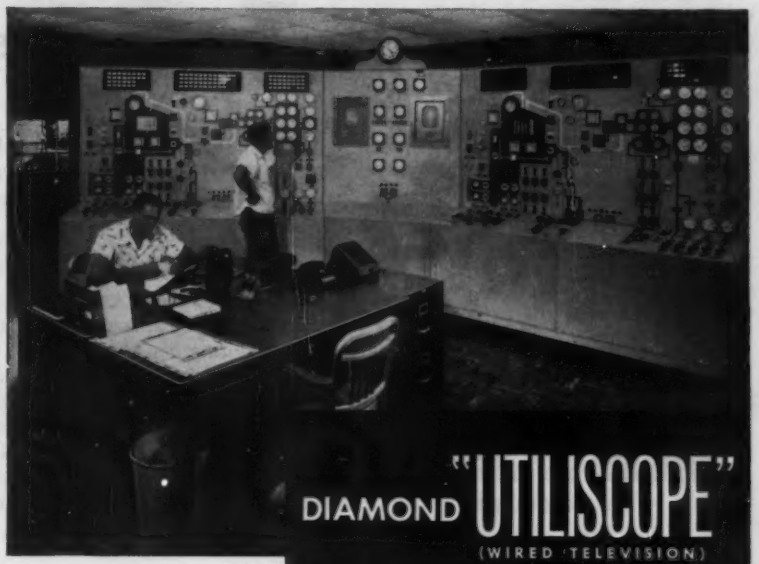
HYDRAULIC OILS: 16 mm film, color and sound, 25 min, no rental charge. Shows the principles of hydraulic laws, reproduces Blaise Pascal's laboratory, and reviews applications of Pascal's discovery in industry. The Texas Co, 135 East 42nd St, New York 17, N. Y.

MOLDED MASTERS OF THE BTU: Color and sound slide film, no rental charge. Depicts insulation theory, basic materials, production, specifications, and applications. Magnesia Insulation Manufacturers Association, 1317 F Street, N. W., Washington 4, D. C.

FILM CATALOG: Descriptions of 20 industrial films available to all recognized groups at no rental charge are published in a booklet issued by United States Steel Corp, New York Film Distribution Center, 71 Broadway, New York 6, N. Y.

FILM CATALOG: Over 20 films, 16 mm, are described in a booklet printed by Allegheny Ludlum Steel Corp, Oliver Building, Pittsburgh 22, Pa.

AUTOMATION IN POWER PLANTS



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The Diamond "Utiliscope" makes possible the ultimate in automation for power plant control. It enables the operator to see clearly anything that requires visual check. He no longer need depend upon indirect interpretations to know what is happening outside his range of vision.

The operator in the above photograph is watching the ITV image of the water level in two boilers . . . transmitted by "Utiliscope" cameras focused on Diamond Bi-Color water gauges. The water levels are easily and unmistakably read on the viewing screens. There can be no error . . . the level is shown correctly or there is no picture.

The Diamond "Utiliscope" is heavy duty equipment for power plant application. Other power plant uses are: watching flame conditions in boiler furnances, watching smoke emission from stacks, and watching remote entrances for intruders. Have you explored the "Utiliscope's" resources for saving money and improving operation? Use the coupon below for further information.

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News About People

West Penn Power Engineers Get Key Posts

C. M. SKOOGLUND

Two key engineering appointments made recently by West Penn Power Co were the promotions of Carl M. Skooglund to coordinator of engineering and Kenneth N. Reardon to chief electrical engineer.

Skooglund, former chief electrical engineer, is a 36-year West Penn veteran. Since 1921 he has moved up through various engineering posts.

Reardon previously was supervisor of controls engineering. During his 34 years with the utility, he has been assistant relay engineer, design engineer, and engineer-switchgear and controls.

In addition. A. A. Jedrziewski was made project engineer, general office; W. A. Richter, Jr, supervisor of substation engineering; and Harrell Denmead, supervisor of controls engineering.

K. N. REARDON

LILCO Advances Smith to VP

Long Island Lighting Co's board of directors has announced the recent election of Wilmot O. Smith to the position of vice president in charge of gas and electric sales.

Smith, former electric operating manager, has been associated with LILCO since July, 1923, when he joined the utility's electric operating department. He was made assistant vice president and electric operating manager in June, 1953.

In a simultaneous promotion, Charles E. Elbert, secretary, was given additional responsibilities as assistant to Pres John J. Tuohy.

WILMOT O. SMITH

So Cal Ed Makes Executive Appointments

T. M. McDANIEL, JR

Southern California Edison Co has elected T. M. McDaniel, Jr, as a vice president and advanced Bruce Renwick to vice president and senior counsel. In addition, Rollin E. Woodbury was elevated from assistant general counsel to general counsel.

McDaniel has been with Edison since 1956, when he was placed in charge of the company's organization and procedures staff. A 1937 graduate of Stanford University, he previously was a member of Arthur Anderson & Co, accounting firm.

Renwick, VP-general counsel since 1955, was with the law firm of Farrand & Slosson before joining So Cal Ed in 1942. Starting as assistant counsel, he rose to general counsel in 1948.

BRUCE RENWICK

G&W

POTHEADS

A581

A DESIGN FOR EVERY CABLE

Only G&W can supply a complete pothead line—extra high voltage, capnut, soldered porcelain or disconnect—230,000 to 600 volts. High, medium and low pressure. Compound, oil and gas filled. Outdoor, indoor and for equipment mounting.

Specify G&W potheads for your cable terminations to be sure that potheads are available for every application.

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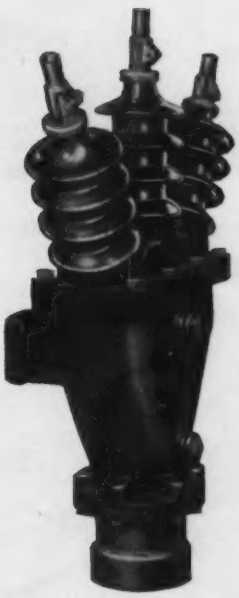
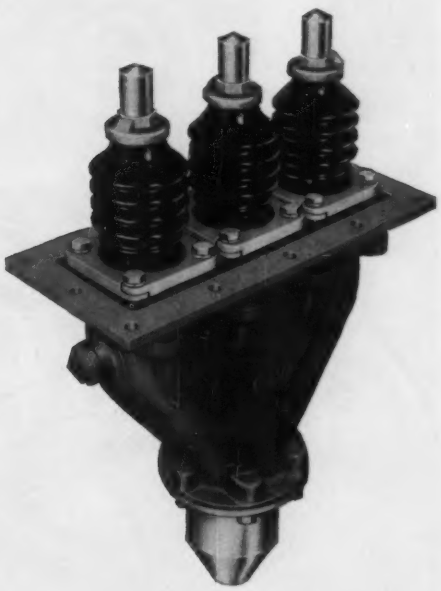




"Heads-up" wiring in Texas...

...as Crain Electric installs Rome's tough power cable at Amarillo's new Olsen Park school

For the long cable pull on this job—from transformer vault to the service connection on the pole—Crain Electric Company needed a tough, abrasion-resistant cable. That's one reason they installed Rome's Rozone-Roseal power cable.

Here are the other reasons why this rugged cable is ideal for almost every type of high-voltage installation—either underground or overhead:

Special polyethylene protection. Roseal is a special flame-retardant polyethylene developed by Rome Cable. It provides excellent resistance to abrasion, moisture, weathering, oils, and most chemicals; and it is considerably easier to pull than other cables. You can install Roseal-jacketed cable underground or overhead, in climates as distinctly different as Amarillo's and Duluth's, and still enjoy the benefits of long cable life.

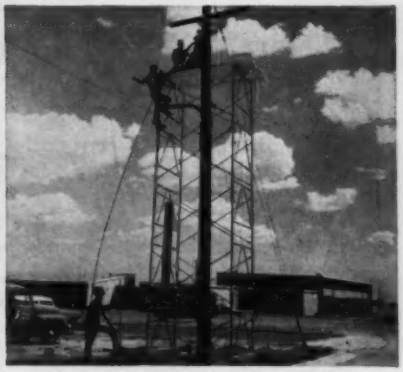
Water and ozone-resistant insulation. A special oil-base insulation—Rozone—assures protection against ozone cutting and moisture. High dielectric and impulse strength makes it an outstanding choice for your high-voltage installations. And its unusual resistance to moisture permits you to bury this cable safely in areas where it must remain immersed in water for long periods of time.

Specify Rome's Rozone-Roseal for your next job. Contact your nearest Rome Cable representative for more information—or write to Department 717, Rome Cable Corporation, Rome, New York.

ROME CABLE
CORPORATION

UNDERGROUND OR OVERHEAD. Power cable leaves reels for underground installation to pole. It's also ideal for overhead use.

EASY TO PULL. This Crain Electric Company workman guides Rome's high-voltage power cable into conduit at the start of a 250-foot pull from Amarillo's new Olsen Park school.



LONG CABLE LIFE. Crain's crew prepares to make the overhead service connection. Because this tough power cable is highly resistant to abrasion, moisture, and weathering, long cable life is assured.

Maxson to Assume New Post

R. D. MAXSON

Raymond D. Maxson will relinquish his duties as senior vice president of Commonwealth Edison Co on April 1 to become senior consulting engineer to the utility and to Sargent & Lundy, engineering firm.

Maxson, who has been in charge of the Dresden nuclear power station now being built, will concentrate on atomic power.

AIEE Honors Hodnette

Winner of the American Institute of Electrical Engineers' Edison Medal for 1957 is John K. Hodnette, executive vice president of Westinghouse Electric Corp.

He was cited for significant contributions . . . through creative design and development of transformer apparatus which marked advances in protection, performance, and service.

J. K. HODNETTE

PERSONAL BRIEFS

Recently promoted by Public Service Electric & Gas Co were **Robert A. Baker,** to assistant chief engineer, electric engineering dept; **Sylvester J. McKelvy,** to industrial relations manager, electric dept; **Henry S. Blauvelt,** to Essex Division substation engineer; **George C. Hess,** to division substation engineer, New Brunswick area; **William T. W. Hoofnagle,** to senior engineer; **John A. Keyser,** to senior engineer, general office; and **William J. Lemieux,** to division meter engineer, New Brunswick area.

Southern Canada Power Co, Ltd, has appointed **S. J. Atchison** as vice president-administration and **Howard Martin** as purchasing agent.

Henry J. Johnson succeeds **Robert Haddock,** retired, as auditor for Public Service Co of Colorado . . . Following the retirement of **C. B. Boulet** as vice president-personnel, Wisconsin Public Service Corp promoted **R. E. Phenicie** to personnel director and **A. H. Schaars** to personnel administrator.

Allen E. Kintigh has been named Eastern Division operating superintendent of New York State Electric & Gas Corp to succeed **Harry E. Duignan,** retired.

A. N. Hoss heads the recently expanded area development department at Portland General Electric Co. Joining the department as area development consultant is **Alan R. Mellis** . . . **Bailey L. Brenn** has been named farm youth specialist for Connecticut Light & Power Co.

The newly created post of general sales manager of Toledo Edison Co has been assumed by **William R. Poole,** former residential sales manager. Toledo Ed's **Henry H. Kerr** retires as vice president and executive engineer on Feb. 1.

New superintendent of Municipal Utilities, Rensselaer (Ind.) is **Thomas Moore,** former superintendent of Lowell (Mich.) Municipal Utilities . . . **R. F. Schaefer** has been made treasurer of PUD No. 1 of Snohomish County, Wash.

Federal Power Commission Commissioner **Frederick Stueck** has been re-elected vice chairman for another year. He has held the office since January, 1957 . . . Huntsville (Ala.) Electric System has named **Frank B. Wilson** to head its new sales promotion department.

The following members of American Institute of Electrical Engineers have been elevated to the grade of Fellow: **E. H. Anson,** Gibbs & Hill, Inc; **G. W. Bean,** Texas Electric Service Co; **R. S. Cannon,** Plantation Pipe Line Co; **C. F. Dalziel,** University of California; **E. N. Dingley, Jr,** Electronic Communications, Inc; **Alois Hoefle,** Toledo Edison Co; **W. M. Joslin,** Commonwealth Edison Co; **D. D. Knowles,** Westinghouse Electric Corp; **D. E. Marshall,** Westinghouse; **John Maxian, Jr,** North American Aviation, Inc; **A. J. Petzinger,** Westinghouse; **R. V. Shepherd,** General Electric Co; **H. D. Snively,** GE; **H. C. Steiner,** GE, and **G. C. Tenney,** McGraw-Hill Publishing Co, Inc.

Engineers Joint Council recently elected **E. R. Needles** as president and **O. B. J. Fraser** as vice president for 1958 . . . New president of the Association of Professional Engineers of B. C. is **George C. Lipsey.**

OBITUARY

James W. Parker, 71, retired president of Detroit Edison Co, died December 30 in Detroit, apparently of a heart attack. A past president of American Society of Mechanical Engineers, he had been with Detroit Ed from 1910 until his 1951 retirement. He had also served with the War Production Board and Atomic Energy Commission.

Frank A. Banks, 74, long-time Reclamation Bureau official and project engineer for construction of Grand Coulee Dam, died recently in Los Angeles after a stroke. He was district manager in charge of administrative and construction phases of the Columbia Basin project from 1945 to 1950, when he retired.

SALES ASSIGNMENTS

COMPANY STAFFS

Allis-Chalmers Manufacturing Co's Industries Group has appointed W. P. Bell as manager of the Washington, D. C., office . . . R. E. Morris has been advanced to manager of the Industries Group's St. Louis district.

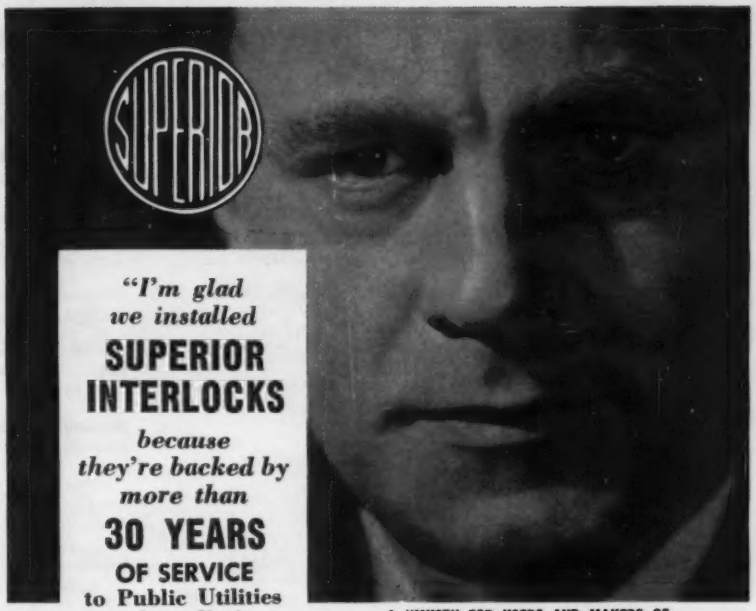
C & D Batteries, Inc, has named William G. Baynard as new sales representative in the Charlotte, N. C. territory. He was associated with the Atlanta sales office.

General Electric Co's large lamp department has advanced Harry W. Bourgeois to manager of the Delta large lamp sales district with headquarters at New Orleans. Gordon E. Brown, his predecessor, has been transferred to Memphis, as manager of the south central sales district.

Graybar Electric Co has transferred W. E. Henges from his post as Erie district manager at Cleveland to Chicago, where he will become central district manager.

Minneapolis-Honeywell Regulator Co has named Louis Belford to the new post of eastern sales manager of the Commercial Division, with offices in New York City. In other changes, Martyn Kingsland was made eastern regional commercial sales manager (to cover New York, Connecticut, Rhode Island, Massachusetts, Vermont, New Hampshire, Maine, and part of New Jersey); Joseph Jester becomes northwest regional commercial sales manager in Minneapolis (for Minnesota, Nebraska, North and South Dakota, and parts of Iowa and Wisconsin); and Robert Patton becomes regional commercial sales manager for the mountain region (Colorado, Utah, Wyoming, and parts of New Mexico, Nevada, Montana, and Idaho.

Motorola, Inc, has appointed Richard G. Jones as district manager of the western area for the microwave and industrial control products component.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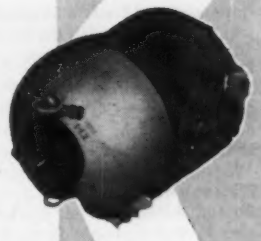

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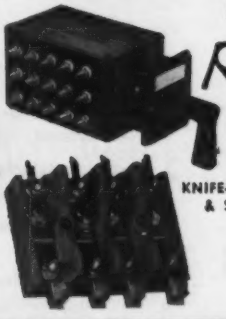

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The Meetings Calendar

JANUARY

Instrument Society of America—Boston Section, Yankee Instrument Fair & Symposium, Hotel Bradford, Boston, Mass., Jan. 14-15.

Edison Electric Institute—Industrial Relations Committee, Mayflower Hotel, Washington, D. C., Jan. 16-17; Dealer Coordination Committee, EEI Headquarters, New York City, Jan. 30-31.

• **National Housewares and Home Appliance Manufacturers' Exhibits**—Navy Pier and Drill Hall, Chicago, Ill., Jan. 16-23.

Southeastern Electric Exchange — Personnel Administration Section, Biltmore Hotel, Atlanta, Ga., Jan. 16-17.

• **Oklahoma Utilities Association**—Accounting Section, Tulsa, Okla., Jan. 17.

New England Farm Electrification Institute—University of Massachusetts, Amherst, Mass., Jan. 22-24.

Public Utilities Advertising Association—Regional Meeting, San Francisco, Calif., Jan. 23-24.

Industrial Heating Equipment Association — Penn-Sheraton Hotel, Pittsburgh, Pa., Jan. 27-28.

American Society of Heating and Air-Conditioning Engineers—64th Annual Meeting, Penn-Sheraton Hotel, Pittsburgh, Pa., Jan. 27-29.

Home Improvement Products Show—Hotel Sherman, Chicago, Ill., Jan. 27-29.

• **Canadian Electrical Association** — Eastern Zone Meetings, Niagara Falls, Ontario, Jan. 27-30.

Annual Doble Engineering Clients Conference—Sheraton-Plaza Hotel, Boston, Mass., Jan. 27-31.

Pennsylvania Electric Association—Engineering Section, Prime Movers and Structures & Hydraulic Committees joint meeting, Pocono Manor Inn, Pocono Manor, Pa., Jan. 30-31.

FEBRUARY

National Association of Purchasing Agents — Public Utility Buyers Group Mid-Winter Meetings, Sheraton Hotel, Philadelphia, Pa., Feb. 2-4.

National Rural Electric Cooperative Association—Annual Meeting, Memorial Auditorium, Dallas, Tex., Feb. 2-6.

Edison Electric Institute — Prime Movers Committee, Penn-Sheraton Hotel, Pittsburgh, Pa., Feb. 3-5; Industrial Electrification Heating Conference, Netherland Hilton Hotel, Cincinnati, Ohio, Feb. 3-6; Industrial Power & Heating Group, Netherland Hilton Hotel, Cincinnati, Ohio, Feb. 6-7; EEI-AGA 1958 Conference Final Planning Meetings, Ben Franklin Hotel, Philadelphia, Pa., Feb. 6-7; Electrical Equipment Committee, Dayton Biltmore Hotel, Dayton, Ohio, Feb. 10-11; Transmission & Distribution Committee, Lord Baltimore Hotel, Baltimore, Md., Feb. 11-12; Meter & Service Committee, Sheraton Hotel, Philadelphia, Pa., Feb. 17-19.

Industrial Electrification Council — National Industrial Heating Conference, Netherland Hilton Hotel, Cincinnati, Ohio, Feb. 3-6.

American Institute of Electrical Engineers—Winter General Meeting, Statler and Sheraton-McAlpin Hotels, New York City, Feb. 3-7.

Missouri Valley Electric Association—Industrial & Commercial Sales Conference, President Hotel, Kansas City, Missouri, Feb. 6-7.

NATIONAL ELECTRICAL WEEK WILL BE OBSERVED FEBRUARY 9-15.

American Public Power Association—Engineering & Workshop Meetings, Chattanooga, Tenn., Feb. 13-14.

Pennsylvania Electric Association—Relay Committee Winter Meeting, Bellevue-Stratford Hotel, Philadelphia, Pa., Feb. 13-14; System Planning and Transmission & Distribution Committees joint meeting, Penn-Sheraton Hotel, Pittsburgh, Pa., Feb. 20-21; Electrical Equipment Committee Winter Meeting, Hotel Roosevelt, Pittsburgh, Pa., Feb. 27-28.

National Society of Professional Engineers—Spring Meeting, Michigan State University, East Lansing, Mich., Feb. 13-15.

American Institute of Mining, Metallurgical, and Petroleum Engineers—Annual Meeting, Hotel Statler, New York City, Feb. 16-20.

National Wiring Sales Conference — Statler Hotel, Detroit, Michigan, Feb. 20-21.

MARCH

Southern Safety Conference, Inc—Exposition, Peabody Hotel, Memphis, Tenn., March 2-4.

Pacific Coast Electrical Association — Business Development Section, Statler Hotel, Los Angeles, Calif., March 6-7; Engineering & Operations Section, Sheraton Palace, San Francisco, Calif., March 27-28.

Lighting Lamps and Electrical Manufacturers Salesmen's Association—First National Lighting Exposition, Coliseum, New York City, March 9-12.

Nuclear Congress—Co-sponsored by American Society of Mechanical Engineers and the Engineers Joint Council, International Amphitheater, Chicago, Ill., March 16-22.

National Association of Corrosion Engineers—Annual Conference & Exhibition, Municipal Auditorium, San Francisco, Calif., March 17-21.

American Society of Mechanical Engineers—Management Conference Committee, Hotel Somerset, Boston, March 19-20.

Edison Electric Institute — Industrial Relations Committee, Headquarters, New York City, March 20; Annual Sales Conference, Edgewater Beach Hotel, Chicago, Ill., March 24-27.

Institute of Radio Engineers—National Convention, Waldorf-Astoria Hotel and Coliseum, New York City, March 24-27.

American Power Conference—20th Anniversary Meeting, Sherman Hotel, Chicago, Ill., March 26-28.

Southeastern Electric Exchange—Annual Meeting, Boca Raton Hotel and Club, Boca Raton, Fla., March 31-April 2.

• Additions this week.

MORE BIG DATES FOR '58

American Public Power Association—Annual Meeting, New Orleans, May 6-8.

National Association of Purchasing Agents — Annual Convention, Chicago, May 11-14.

Edison Electric Institute—26th Annual Convention, Boston, June 9-12.

American Institute of Electrical Engineers—Summer General Meeting, Buffalo, June 22-27.

National Electrical Manufacturers Association—Annual Meeting, Atlantic City, Nov. 10-14.

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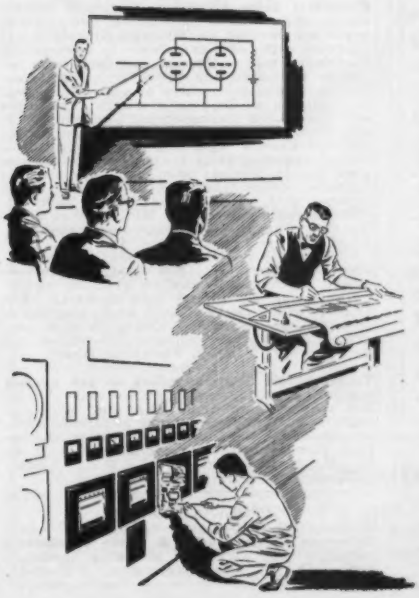

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Near your plant—wherever you're located—is one of the more than 100 Honeywell sales and service branch offices. It's staffed with experienced service engineers and well stocked for emergency parts replacement. Additional parts and accessories are easily ordered through your local branch from the Central Supply Depot in Philadelphia.

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MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

Honeywell

First in Controls

Delayed Coke Used

(*Continued from page* 66)

tribute to one primary problem, maintaining rated superheat and reheat temperatures. This problem is accentuated at maximum output as cold reheat temperature is about 40F below the specified value. To obtain rated hot reheat temperature, it is necessary to operate the burner tilt 25 to 30 deg above the horizontal and to provide maximum desuperheating spray in the superheater of the unit.

With the burner tilted thus, combustible content of the fly ash ranges from 35 to 40%. This condition can be alleviated somewhat by increasing the excess air. If burner tilt can be operated in the horizontal position or below it, combustible content may be reduced below the specified 30% when burning the 50-50 mixture.

The pulverizers have operated satisfactorily. Power requirements when grinding the coal-and-coke mixture are considerably below those for coal alone. Some difficulty was encountered in determining the degree of fineness in grinding the fuel combination. Initially, mills were calibrated on 100% coal and rechecked at 100% coke. Screening of samples disclosed that coal and coke particles tend to form small pellets which would not pass through the 200-mesh sieve. Overnight drying of samples in a 160F oven appears to have eliminated this problem.

In calibrating pulverizers, it was necessary to increase fineness through the 200 mesh to above 80% to reduce the quantity of material retained on the 50-mesh sieve.

Air pollution from the coal-and-coke operation and fly ash from the stack have been a nuisance. The dust created in coke handling and reclaiming is excessive, being highly bouyant in air and apparently impervious to surface moisture. Although wetting agents have been considered, air drying piles serve as active storage, so that wetting seems impractical.

Multicyclone mechanical dust collectors were installed on this unit because an electrostatic precipitator might not function effectively due to the high carbon content of the fly ash. Space has been provided for a possible future electrostatic precipitator unit.

The high acidity of the fly ash required dry handling rather than the conventional sluicing to ponds. This system prevents stream pollution in the area.

Preliminary performance data indicate that station heat rate is about 125 Btu per net kwhr higher when burning equal portions of coal and coke than when firing coal alone. These results closely approximate design data. Station performance indicates that many problems have been overcome, although a few remain. The corrosive effect of vanadium and sodium remains an unknown factor.

The cost of the initial unit approximated $24,000,000. This cost includes the circulating water induction and discharge systems and service and shop facilities for ultimate development, together with facilities common to Unit No. 2, but not local charges, land, and interest during construction. Cost of the duplicate unit scheduled for operation next November has been estimated at $21,000,000. Features in the design of the initial unit to permit the use of delayed coke cost about $275,000.

Distribution Revamped

(*Continued from page* 63)

a fire or explosion in the plant.

Pilot wire differential relays (87L) at each end protect the two cables that make up the 2,400-ft, 13.8-kv underground feeder. Pilot wire supervisory equipment, with the sending end in the power house and the receiving end in the mill, monitors the condition of the pilot wire. Back-up protection is provided by an induction overcurrent relay with an inverse time characteristic, in the power house. At the mill end of the feeder, additional protection is afforded by an instantaneous overcurrent relay with a hand reset auxiliary relay. An identical system protects the 13.8-kv overhead feeder. There is no relaying on the 440-v system except in the unit substations. Substation circuit breakers have overload protection and instantaneous relaying for short-circuit protection.

Searchlight Section

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We are looking for graduate electrical engineers to represent us as application engineers in the field. Requirements are that you be between 29 and 40 years of age and have had five years of engineering and construction experience with a power company. This is not a sales job, but your responsibilities will require extensive travel. Starting salary is $8,000.00 to $10,000.00 per year plus expenses. This includes whatever training period is necessary to thoroughly acquaint you with our line of products. The position of application engineer, in addition to its intrinsic value and importance, is one from which substantial further benefits can be realized. If you feel that your background might qualify you for such a position, and if you desire a future that offers security together with increasing opportunity, send details of background and experience together with a recent photo to S. Frank,

P-6807, Electrical World
520 N. Michigan Ave., Chicago 11, Ill.

All information will be kept strictly confidential.

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Electrical Sales Engineer—Excellent opportunity with firm of consulting management engineers located in Chicago for electrical engineer with some experience in contracting customers, selling through distributors or retailers or contacting or servicing utilities. Will work under direction of a vice president of company of leading electrical appliance and equipment manufacturer accounts. Will also contact top level officials in manufacturing and electric light and power companies. Travel required from fourth to third of the time. Salary depends upon man's age, qualifications, experience and potential. Send resume, with photo if possible, to Robb M. Winsborough, Vice Pres., Middle West Service Co., Consulting Management Engineers, 20 N. Wacker Dr., Chicago 6, Ill.

Electrical Engineer. Board layout work—power, lighting, and control systems; calculations; and occasional field contacts. Extremely wide variety of work with opportunity to enter consulting field and grow with progressive midwestern concern. All replies will be answered. P-6902, Electrical World.

Transmission Superintendent — for system consisting of 725 miles 69 kv and 115 kv line serving municipal, REA and industrial loads of 120,000 kw. Must supervise lines, substations, communications, meters and relays. Send complete experience record to W. B. Hoss, Manager, G.R.D.A., Vinita, Oklahoma.

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400	Al-Ch	2300	240/120
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250	G.E.	440	250
200	West.	2300/4000	250
200	G.E.	2300	250/275
200	Rdgwy	2300	250
150	Al-Ch	2300	250/275
150	G.E.	440	257/275
150	West.	2300/440	250/125
125	G.E.	5000	250
125	West.	2300	250
125	C.W.	4160	125
100	G.E.	2300	250
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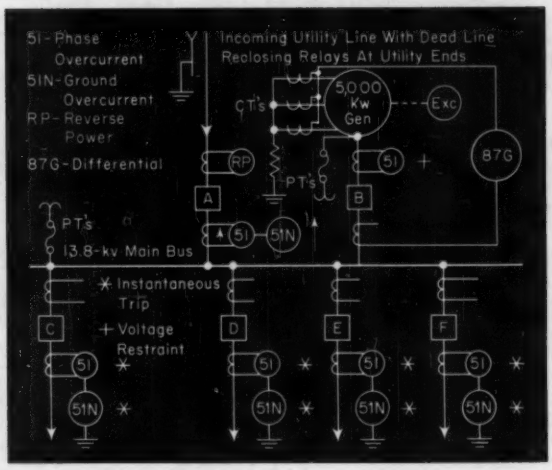


Industrial Relaying Charts Corrected

To the Editor:

I have noted the following comments on charts in the industrial relaying article in the October 28, 1957 issue of Electrical World, page 59. I do not believe these errors appeared in my diagrams, but if they did, I am truly sorry. Possibly these corrections should appear in a subsequent issue for clarification.

In Figure 2

"RP" is a reverse power relay as indicated in the text, not a directional overcurrent relay as indicated on original diagram. (See corrected version above.)

The current transformers in the generator neutral are shown with their secondaries tied to the generator neutral leads. They should be represented like all the other current transformers in the diagram with the primary isolated from the secondary. All three neutral current transformer secondaries are then tied to the 87G relay as shown.

In Figure 3

Substation A is 500 kva, not 2,500 kva. It would be impossible to coordinate a fuse in this size transformer with the relay on the 13.8 kv breaker.

In Figure 4

The designation at the lowest arrow should be "13.8 Kv Brkrs., Bldg. Y," not Bldg. 16. The breakers in Bldg. Y were numbered 15 and 16 at one time.

R. R. Peatfield
Stone & Webster Engineering Corp.
49 Federal Street
Boston 7, Mass.

Prophet Is Honored

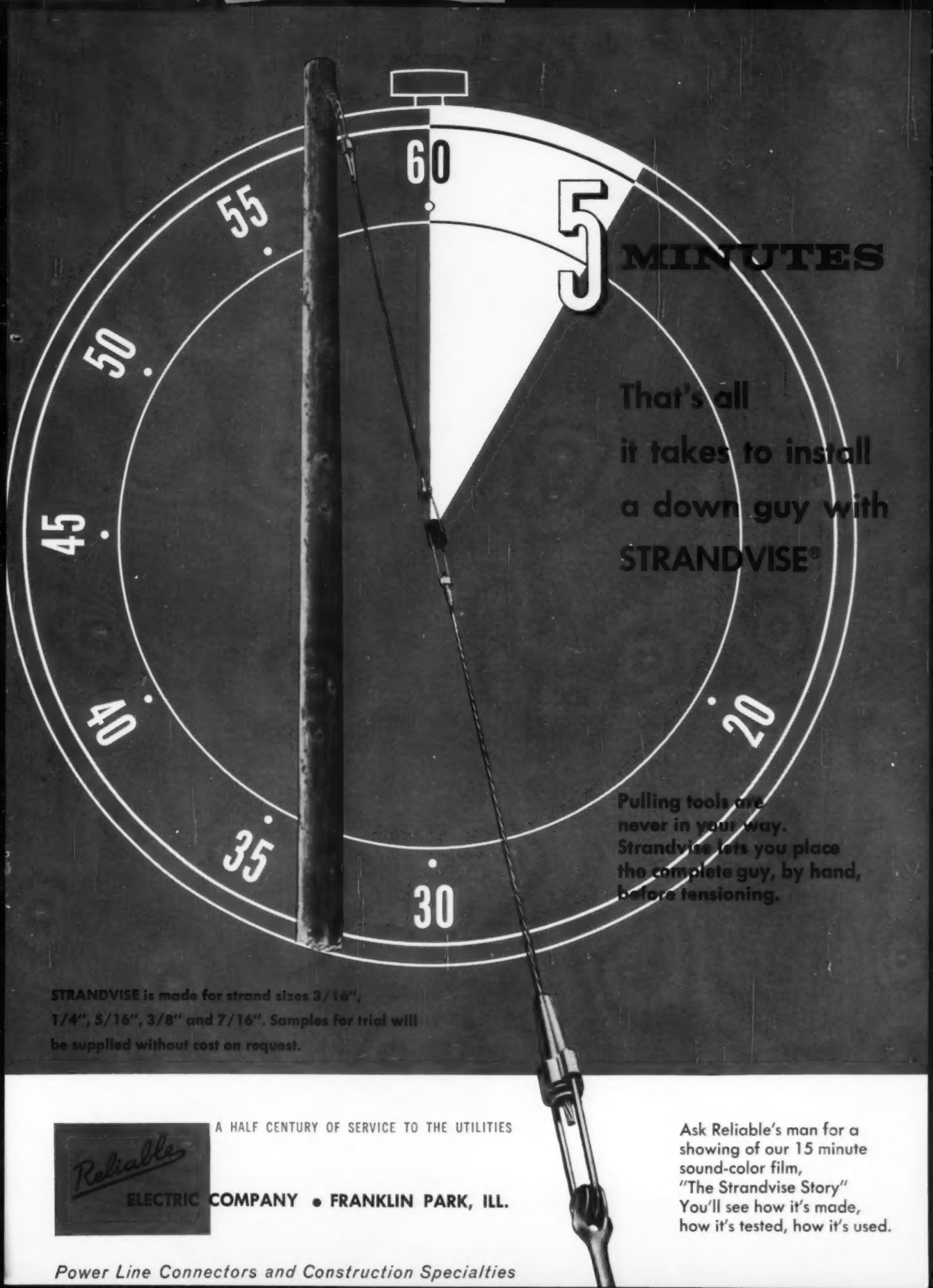
To the Editor:

This is a tardy date to congratulate you and your associates on the grand treatment you gave the article by Messrs Turnbull and Jamison of our client company, Western Massachusetts Electric Company in your November 11th issue.

As you know, it was just ten years ago this Fall that I started a one-man campaign to alert the Industry to the value and practicability of controllable Space Heating. It makes no difference what old curmudgeon Leffler tries to start—I have never claimed that any ideas would be accorded recognition until at least ten years have past.

Your November 11th Cover—got me "under the wire" by a nose.

William S. Leffler
Engineers Associated
17 Baywater Drive
Darien, Conn.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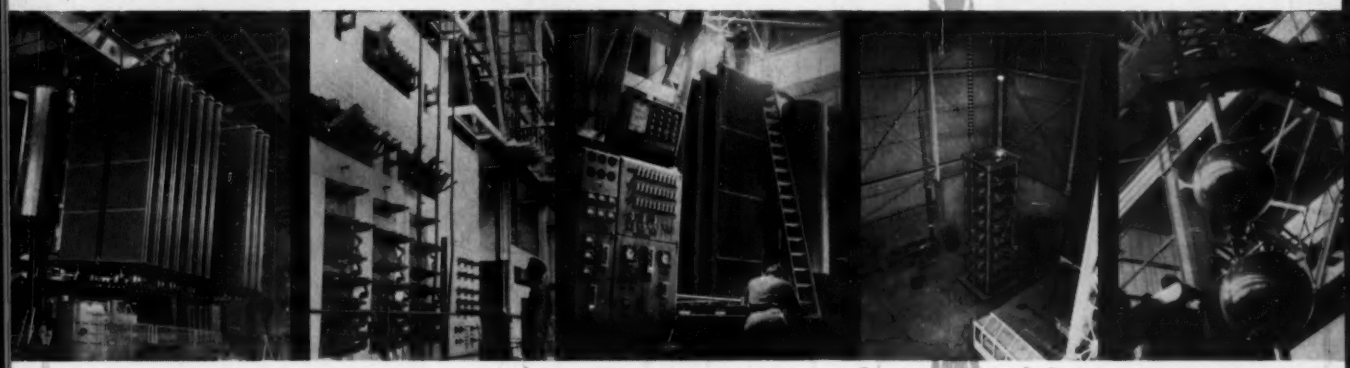
TESTING

When ordering power transformers—consideration should be given to the performance record of the manufacturer. To assure proper performance, extensive test facilities are necessary. Moloney has constantly expanded their testing facilities to maintain an enviable record of performance and reliability.

MEES-36



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